OCT 17 1923

TELEPHONE ENGINEER

VOLUME 27 OCTOBER, 1923 Number 10

Strowger Automatic

The Standard of the World

Sound engineering principles, thorough research, and more than thirty years of extensive operating experience are the three outstanding features of the development of Strowger Automatic Telephone Equipment.

This development has resulted in Strowger Automatic Equipment being adopted as the standard for future installations in both large and small cities by the world's greatest telephone operating organizations.

Automatic Electric Company

FACTORY AND GENERAL OFFICES: CHICAGO, ILLINOIS

BRANCH OFFICES IN ALL PRINCIPAL CITIES

ASSOCIATED COMPANIES

INTERNATIONAL TELEPHONE SALES AND ENGINEERING CORPORATION, New York

International Automatic Telephone Company, Ltd., London

Automatic Telephone Mfg. Co., Ltd., Liverpool

Compagnie Française pour l'Exploitation des Procédés Thomson-Houston, Paris

Automatic Telephones, Australasia, Ltd., Sydney

EQUIPPED WITH EITHER FIXED OR ADJUSTABLE TRANSMITTER HEAD

No. 113 DESK STAND

MAGNETO OR COMMON BATTERY

Test of service puts this instrument in first place

Sturdy Construction, Simplicity of Mechanism, and Electrical Correctness Spells Economy and Dependability. Standard apparatus is employed throughout making this instrument practically unexcelled for efficiency in service.

Secure satisfied Subscribers by installing THESE "QUALITY" TELEPHONES.

Prices and detailed information furnished on full line of SWITCHBOARD and TELEPHONE equipment.

WIRELESS

We are prepared to supply

HEAD RECEIVERS, MICROPHONES, KEYS, JACKS, PLUGS, ETC.

American Electric Company

CHICAGO, U. S. A.

A stock of our standard equipment is carried in stock by a distributor in your territory

TELEPHONE ENGINEER, October, 1923, Volume 27, No. 10. Published monthly by TELEPHONE ENGINEER. Publication office, 28 E. Jackson Blvd., Chicago, Ill. Subscription price $2 a year in the U. S. Entered as second class matter June 6, 1922, at the Post Office at Chicago, Ill., under act of March 3, 1879.

GENERAL OFFICES:
28 E. JACKSON BLVD.
CHICAGO, ILL.
Tel. Harrison 4000

TELEPHONE ENGINEER

EASTERN OFFICES:
56 W. 45TH ST.
NEW YORK
Tel. Vanderbilt 3695

VOLUME 27 OCTOBER, 1923 Number 10

DIVISION OF TERRITORY IS NOT OBSOLETE

News of the plan of division of territory and elimination of competition in eastern Pennsylvania between the Consolidated Telephone Company and the Bell of Pennsylvania should be reassuring to those who have felt a certain amount of apprehension as to the future of Independent companies. The Bell companies are not definitely committed by the Hall memorandum to a policy of division of territory where duplication of service is to be removed. Many people have felt that this meant that the only method of consolidation that would be considered is outright purchase by the Bell.

In the Consolidated-Bell of Pennsylvania deal, the Independent company gives up part of its territory and takes exclusive control of another part. After duplicate service has been removed it will have a somewhat larger number of stations in its exclusive territory than it had in the entire territory previously. Operating over a smaller and more compact territory, with the burden of competition removed, an active and energetic management will have the opportunity of developing a strong unit in the telephone field.

The action of the Bell in this as well as in other cases seems to indicate a willingness to leave the ownership of Independent properties in local hands, particularly in cases where the local owners are able to care for development and are willing to supply satisfactory terminal facilities for long distance traffic. To the man on the outside, there seems to be little danger of an aggressive buying policy directed toward the acquisition of companies where the management wishes to stay in the telephone business and is willing to develop it in a business-like way.

LET'S ALL GO TO CHICAGO!

In the telephone industry, October has come to mean the month of the convention of the United States Independent Telephone Association. As it comes around each year, Independent telephone men begin to look forward to the announcements of the program and to make plans for attendance.

These conventions, in recent years, have been notable for the absence from the programs of matters of a controversial character, and for the constructive character of the papers and discussions. This year's convention program, which appears in another column, far from being an exception, goes even farther along these lines. Ethics, employees' benefit plans, financing, substation protection—all are matters of direct importance in the operation of every company. Old timers will appreciate the entire day set aside for the Independent Pioneer Telephone Association.

To many, the trip to the convention is a matter of course. To others there is only one thing to be said: Lay aside the routine cares for a week and join your fellows in Chicago.

Full particulars regarding railroad rates, hotel accommodations, exhibit spaces, etc., in connection with the National Telephone Convention at Chicago, Oct. 23-26, may be had by addressing the U. S. Independent Telephone Assn., 19 South La Salle St., Chicago. Telephone Randolph 5255.

THE GROWING SERVICE ORGANIZATION IDEA

The suggestion made in these columns in August, that there should be organized in the Independent field a service similar to that given by the American Telephone and Telegraph Company to subsidiary companies, seems to have struck the mark. It has been the subject of discussion among telephone men whenever they have met and we have printed letters from a number of leading men in the field in regard to it.

In this issue, we have a letter from President MacKinnon of the United States Independent Telephone Association who has undoubtedly given as much thought to the subject as anyone in the field. Mr. MacKinnon draws attention to the service which the National Association has rendered in Federal Government matters and which the state associations give in state matters and he indicates that a service should be given in engineering, traffic and commercial problems. These latter services the companies have never had and they do not appreciate the advantage that they would derive from them.

The question is largely one of proper financial support of the associations and of closer co-operation between national and state associations. Given the financial support the question of co-operation can easily be worked out. Telephone companies must come to see that a slight increase in their payments to associations, if invested in service of the kind suggested will pay a handsome return.

It is to be hoped that discussion

of this project will form an important part of the proceedings of national and state conventions and that out of these discussions will grow a definite plan for a comprehensive service organization.

RATE-MAKING IN THE COURTS

In recent issues of a number of daily papers, have appeared editorials commenting on certain features of utility regulation involved in cases where appeals have been taken to the Federal Courts. Whether or not there has been an increase in number of cases taken to the Federal Courts by the utilities, it is certain that they are receiving more attention from editorial writers. While it is true that most of these have appeared in cities directly affected by the cases, nevertheless, the comments may indicate a trend of opinion that will influence future policies in regulatory affairs. The burden of most of the comments is dissatisfaction with what the editorial writers are pleased to call rate-making by the Courts. Some of them go as far as to say that, if all the important decisions of the commissions are to be taken to the Federal Courts, the commissions may as well be dispensed with as being an unnecessary investigating body without real power of enforcing its decisions. Others criticise the utilities for carrying the cases into the Federal Courts instead of submitting them for review to the State Courts as provided by most utility acts.

When a commission order establishing rates clearly violates some of the well defined principles of rate-making or where the rates set up will obviously fail to bring a return that will invite the investment of new capital in the enterprise, it is the duty of the management to appeal to the courts for relief. It is unfortunate that there have been a number of decisions recently in which the management of the utility involved felt it necessary to make such appeal. It has been suggested, whether justly or not we do not know, that the commissions in some of these cases have established rates that they know would not hold in court and that this was done to place on the courts the onus of increasing the rates.

It may be possible that some commissions with an eye to politics rather than to justice have done this. If it is true, there may be a temporary political advantage, but in the long run, a commission with a long record of reversals in court will lose the confidence of the public that created it. This loss of confidence must surely result in the reorganization of the commission personnel or in the complete abandonment of the commission form of regulation.

DIVIDENDS A NECESSITY

Recently the manager of a certain telephone made an application for increased rates, alleging insufficiency of revenue to pay a fair return on the investment. The purpose of the increase in rates applied for is frankly given as a desire to inaugurate a dividend policy. The company has been earning operating expenses and some surplus in the past but has never paid dividends. It was organized as a mutual concern some twenty-five years ago and has several hundred stockholders, most, if not all, of them being users of the service.

In the process of development, subscribers who were not stockholders have been given service until the latter outnumber the stockholders two to one. Funds for development have been secured from surplus earnings and from investment of depreciation reserve. Cramped by the limited resources available, the company has done much makeshift work and its plant is now in condition where it needs extensive rebuilding.

Probably the majority of the stockholders who put in money years ago in order to secure service without expectations of dividends are not much concerned about the absence of return, but the manager is quoted as having said that the company has finally reached the place where it can not secure new money for needed replacements, much less for extensions and improvements, unless it can be placed on a dividend paying basis. Development in its territory must end and the plant be allowed to go to the scrap heap unless new money can be secured.

Here is something for managers and public service commissions to think about. When a company, organized originally on a "not for profit" plan finds a dividend paying policy absolutely necessary for its development, what can be said about the ordinary company? What will be the conditions, ten years from now, where companies have failed to demand rates that will pay a reasonable return to the stockholders or where commissions have failed to allow such return where applications have been made? Can the telephone business continue to grow and expand under these conditions? The answer is obvious.

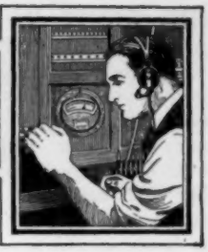
TELEPHONE ENGINEER
Vol. 27 October
No. 10 1923
Entered as second-class matter. June 6, 1922, at the post office at Chicago, Ill., under the act of March 3, 1879.

General Business and Editorial Offices, 28 E. Jackson Blvd., Chicago, U. S. A. Telephone: Harrison 4000.
W. H. Graffis.....Gen. Mgr.
R. V. Achatz.....Technical Editor
Chas. W. McKay.....Associate Editor
Herbert Graffis.....Bus. Mgr.
Jos. M. Graffis.....Advertising Mgr.
G. W. Sutton.....Eastern Mgr.
56 W. 45th Street, New York
Tel. Vanderbilt 3695

SUBSCRIPTIONS
The subscription price of TELEPHONE ENGINEER is $2 a year in the United States, Cuba and Mexico; in Canada it is $3; in all other countries $4. Single copies, U. S. A., 20 cents.

ADVERTISING
TELEPHONE ENGINEER is issued the 15th of each month. Copy can be accepted as late as the 8th of the month preceding date of publication. Where proof must be seen, allow ample time for transmission in the mails. Display Advertising—Rates on application. Classified Advertising—"Wants," "For Sales," etc.—$3 an inch, or 6 cents a word per insertion.

LINE AND DESK



SALVAGING OLD MAGNETO GENERATORS

Like most small telephone companies we have a store room full of old magneto instrument parts. During some spare time it was decided to salvage the good material and junk the rest. Among the parts we found a number of old magneto generators. Some had weak magnets, some had burned out coils, some defective springs and a number of them had end plates made of whitish metal that had cracked or broken. A complete test was made of each generator and a tag was put on to show the necessary repairs. Obsolete types were put aside to be used for small repair parts.

If there were several generators of one type, parts were taken and as many good generators were assembled as possible. All magnets were remagnetized on a home-made coil. Some of the burned out armatures were sent to the manufacturer for rewinding if the magneto was good otherwise.

We then made a complete list of parts needed to repair those that were left and we found by writing to the manufacturers that they could furnish nearly all of the repairs. New end plate, springs for the pinion wheels, contact springs and bushings and other parts were ordered and when they came the generators were repaired.

We succeeded in getting about 15 first class generators out of what we had thought was a junk pile.—Contributed by E. R. C.

"BUGS WE HAVE SHOT"

In making some repairs to a receiver it was necessary to remove the pole pieces from the permanent magnet. After it was put together again, it failed to come up in transmission and was thrown aside temporarily. Later the need of a receiver made me take another look at it. I found that in reassembling it I had used an iron screw to fasten the pole pieces to the magnet, instead of the brass screw that was furnished. The magnetism found a better path through the iron screw than through the air gap and diaphram and the receiver would not talk up.—Contributed.

AN EXPENSIVE TWO-DOLLAR BILL

A young man once found a $2.00 bill in the road. From that time on he never lifted his eyes from the ground when walking. In the course of forty years he accumulated 29,516 buttons, 54,172 pins, seven cents in pennies, a bent back and a miserly disposition.

He lost the glories of the sunlight; the smiles of friends; the songs of birds; the beauties of the flowers, trees, blue skies, and of all there is in life worth living for—the opportunity to serve his fellow men and spread happiness.

This happened many years ago. If this had taken place in our present age of hustle and hurry and reckless automobile driving this young man would have either been killed or crippled for life long before the forty years were up. But at that it describes what is wrong with many people today. If each employe would be alert, observe and consider what is going on around him there would be fewer cases of injury caused through carelessness and omission on the part of others.—Southwestern Telephone News.

SUBWAY SUMMER RESORT

Of all places to go to keep cool during the hot summer days, probably Charles A. McClafferty picked the queerest. Here we have him in a manhole under one of the streets of Havana, Cuba, with an electric fan to

coax the gentle zephyrs seldom found under tropical thoroughfares. He is whiling away his time on the splicing of a new 1,200-pair cable for the Cuban Telephone Co.

RESPONSIBILITIES AID ECONOMY ON THE JOB

If the men in the field would use their own initiative in bringing about a more systematic method of work on all jobs, a great saving of a very few minutes here and there would eventually mean a great deal. It is not a matter for me to judge the amount of responsibility that should be placed on any particular man, but I do believe that authority should be vested in the immediate supervisors to bring about the objective of economy.

It is my belief that there is a minority of men in the field who fully realize the cost value of the minor items of material. If a list of the cost prices of the minor items of material daily in use, such as bridging connectors, carbons, screws, cleats, etc., were posted in the stockroom, it always would be a reminder of the money value, and might stop some of the waste.

We would gain in economy, if the man, in taking material from the stockroom, would be more careful in arranging it with some system on the truck or other vehicle used.

If the tool boxes always were kept neat and orderly, a certain amount of lost time that is spent in digging about in them for tools would be avoided.

If, in stocking material, more pains were taken to have a place for everything and the place of each item marked in such a manner that the sizes and kinds of material wanted could be readily gotten to without looking and poking about, it would help.

It is a habit with some men to be a little careless in these respects. How often men will take material and remove the container or box or carton and throw it on the floor or let it lay around for the other fellow to pick up. That takes time.

If the man in the field sees some part of the plant that is not in use, why not recover it and place it in stock?

Any number of pole attachments that are vacant could be taken off and later placed in use, thereby cutting down the amount of material charged to the exchange.

—Carl Berling in "The Mouthpiece."

THE RIGHT TOOL FOR THE JOB

Rapid depreciation of switchboard equipment is sometimes caused by the use of improper tools when current repairs are being made. The ordinary tools of the repairman's kit, side-cutting and long-nosed pliers, diagonal cutters and screwdrivers, are suitable for some of the work, but in making certain kinds of repairs, they may do more damage than good. Manufacturers have developed special tools for switchboard repair work and their use is common in larger offices. In smaller offices, particularly where

SWITCHBOARD TOOLS

FURNISHED WITH THE

No. 105 MAGNETO SWITCHBOARD

BY THE

STROMBERG-CARLSON TELEPHONE MFG. CO.

ROCHESTER, N. Y., U. S. A.

switchboards are of the magneto type, these special tools seem to be practically unknown.

One manufacturer has recognized this need in the smaller offices and is now furnishing with magneto switchboards, a card of special tools. This card is arranged conveniently for mounting on the wall near the rear of the switchboard and the tools are held in place by loops of elastic cord. When a tool is removed an outline drawing shows in its place. Below each tool is a brief description of its use and the code number and price are given for convenience in ordering duplicates or additions.

The set is made up of five tools. The first is a small stamped wrench which is designed to be used for removing the nuts that hold the jack thimbles. The second tool from the top of the card is a special screwdriver for plug screws. One end is a small screwdriver of just the right size for use in the small screws which hold the plug shell and the tip and sleeve connections. The other end is drawn out to a small rounded point which may be forced into the small hole in the head of the screw, thus enabling it to be handled more readily. The third tool is a small screwdriver, just the right size for drop, number plate, key escutcheon and drop terminal screws. The fourth tool is a larger screwdriver for the screws that hold drop mountings, key mountings, etc. The last tool is a contact spring adjusting tool. The L-shaped end is dressed down and slotted so that the slot will engage the edge of the contact spring. In using this tool, the spring should be bent at a point as near the insulation as possible.

The tools of this set not only add to the convenience of making switchboard repairs but will prevent damage to delicate parts of the apparatus that might result if tools unsuited to the job were used.

THE TALE OF A TICK

Just a plain old-fashioned tick. Not the kind that covers a mattress nor the crawling kind. Neither is it the kind you hear spoken of in regard to the weekly supply of groceries. This is a story of a clock tick, made by an old-time mantel clock which rendered a helpful service to a telephone repairman by its loud ticking.

This is how it happened. Rural line number 8-F of the Warwood Exchange was reported "permanent" one afternoon sometime ago and the repairman, upon making the voltmeter test, ascertained that the line was "short"; i. e., was short circuited.

By operating the R. C. key on the test board and listening on the line very closely he thought he could hear a clock ticking. This ticking which he heard indicated that somewhere on the line a receiver had been left off the hook.

After repeated attempts to attract the attention of the subscriber by the use of the howler, the repairman decided the folks must be out feeding the chickens, milking, plowing or doing some other of the many farm duties.

Being familiar with the location of each telephone on this particular line, the repairman thought over the matter a moment and decided that the only place where the telephone instrument was in the same room with a clock was at Jones', which was about three miles out from the office.

He decided to verify his conclusions by immediate action so he hopped in the "Rolls Ruff" and sped out to ring 1-2, where, upon being admitted to the room where the telephone was situated, he found the receiver off the hook.

Old "Regulator" was ticking away on the mantel and each tick seemed to say, slick, slick, slick, slick.

Moral: Know your territory. It pays.—Wheeling, W. Va., Repairman, in the Transmitter.

NATURE'S STEPS

This interesting specimen of a pole with natural steps is located at Bridgeport, Okla., says the Southwestern Telephone News. It is an Oklahoma

grown red cedar pole. We are not sure that we can recommend to our readers this style of pole for general use.

HOW ARE YOUR BRAKES?

Under the above caption, The Travelers Standard, a publication of the Travelers Insurance Company devoted to safety, gives some valuable hints as to the proper maintenance of brakes on motor vehicles. Defective brakes are the cause of many accidents and since telephone companies are large users of motor vehicles some of the suggestions will be of interest. The article describes the ordinary method of testing brakes and makes suggestions regarding the proper adjustment of brake rods, bands and equalizers.

The rule for the distance a car will run before it can be brought to a

(Continued on page 25)

Cord Circuit Requirements

A Study of Two Types of Common Battery Multiple Switchboards with Reference to the Number of Cord Circuits Required Per Operator's Position

By D. E. Wass

Within in the past few years many common battery switchboard installations of moderate size have been installed in which the subscriber's line lamp is associated with the multiple jack, and appears in the multiple of each section, thereby eliminating the answering jack and at the same time making the call appear before all operators on the board. In the cases where such equipment is used, usually the automatic features such as automatic ringing and listening, peg count and revertive ringing tone are employed on the cord circuits.

In this type of equipment there are usually fewer positions for a given number of subscribers' lines than in the straight multiple board. This is due to the greater load the operators can handle. An interesting point is that the number of cord circuits per position remains practically the same in the two types. Operating people have noted this fact, and they have frequently asked if the number of cord circuits per position in a feature board is sufficiently great to handle the calls without delay due to all cord pairs being busy. While a partial answer might be given by pointing out that the features of the board tend to reduce the time that a cord is in service on a connection, and thus reduce the total number of cords required, it does not complete the explanation. An application of the theory of probabilities to this question is the only exact means of arriving at an explanation.

Data Are Assumed for the Problem

As a basis for this discussion, let us make a few justifiable assumptions. Let us assume that we have a No. 1 common battery multiple board serving 2000 lines. The operators on this board are all equally proficient, and the load is equally divided between them. To compare with this, we have a common battery associated multiple board equipped with automatic ringing and listening features, and serving the same number of lines. To distinguish between the two, the multiple board with answering jacks will be referred to as multiple board, and the associated multiple board will be referred to as feature board.

The first point of comparison is on the holding time, and by holding time is meant the time that a cord pair is in service on one call. From the assumption the feature board has automatic ringing and listening features, and it may be expected that the holding time for this type of equipment will be less than for a multiple board. In the following table, the holding time is broken up into its component parts, for the two boards. The figures for the feature board are taken from actual traffic data for the month of June 1921, for a 2000 line feature board. The figures for the multiple board are placed on a basis that is comparable with the other figures.

Item.	Feature Board		Mult. Board.	
Talking time.	69.0	Sec.	69.0	Sec.
Handling time.	4.25	"	7.0	"
Sub. Ans. time.	4.0	"	12.0	"
Total holding time.	77.25	"	88.0	"

Thus from the table, it will be seen that the feature board has the holding time of 77 seconds while the multiple board has a holding time of 88 seconds. Dealing with averages alone, it will be seen that the board having the shorter holding time will require the fewer cord pairs

Average Number of Cords in Use Does Not Give Number Required

But dealing with averages alone does not tell the entire story. A subscriber is as liable to call at any one instant as he is to call at another, and he must be served with the least possible delay to his call. What then is the probability that when a subscriber calls, all cord pairs will be busy, and he must wait for his connection to be completed?

Since both of the boards assumed in the discussion serve 2000 lines, it is a fair assumption to say that each line calls once during the hour, and that this call may come at any time during the hour. From the traffic records of the exchange to which reference was made, an average operator's load of 400 calls per hour was maintained. This figure is checked by records from other exchanges having boards with similar features. For the multiple board, an average load of 230 calls per hour is taken, this figure being standard for such equipment.

We will now investigate the number of cord pairs required in order that the operators may handle the required number of calls on each type of equipment.

For the feature board and dealing with averages, we have the required number as:

$$\frac{77 \times 400}{60 \times 60} = 8.5$$

But the original assumption was that the subscriber was as liable to call at any one instant as he was at another. This throws the problem into the field of probabilities rather than averages.

Theory of Probabilities Can Be Applied

Mr. E. C. Molina in discussing trunking problems in the November 1922 issue of the Bell System Technical Journal compares such a problem to a die throwing scheme. He calls the number of faces on the die the number of times a cord or trunk will be in service in an hour, the number of throws made is the number of calls per hour, and the number of aces thrown is the number of calls on the board at any one time. Furthermore, the probability that a certain number of aces will be thrown is the probability that a certain number of calls will be on the board at that one time.

In the first place will be considered the case where calls that fall in front of each operator can be answered only by that operator. Obviously if there are seventeen cord pairs per position, and there are eighteen calls on this one position at one time, one of these subscribers must wait until a cord is available before his call may be answered. It is such a condition as this that we are interested in.

Since there are seventeen cord pairs per position on a feature board, and since the holding time is 77 seconds, each cord pair is capable of being in service 46.7 times per hour. The

proposition may then be stated in this manner. The probability that when a subscriber calls there will be no idle cord pair to answer his call is the same as the probability that eighteen aces will be thrown when 400 trials are made with a die having 46.7 faces.

Table 1 at the end of this article is taken from the Molina article, and it shows the probability for various number of trials, number of faces and number of aces thrown. By referring to the column marked "deviation plus average" to the line 17, and following over in a horizontal direction, we have two values, one 8.41, and the other 8.68. By interpolating between the two, we have the probability determined as .007. Resolved into the terms of the problem, this means that seven times in each thousand calls, there will be no idle cord pair on this position. Since the busy hour load is taken as 2000 calls per hour, this condition will exist 14 times per busy hour for the entire board.

Applying the same sort of reasoning to the multiple board we have the average number of cord pairs required as:

$$\frac{88 \times 230}{60 \times 60} = 5.64$$

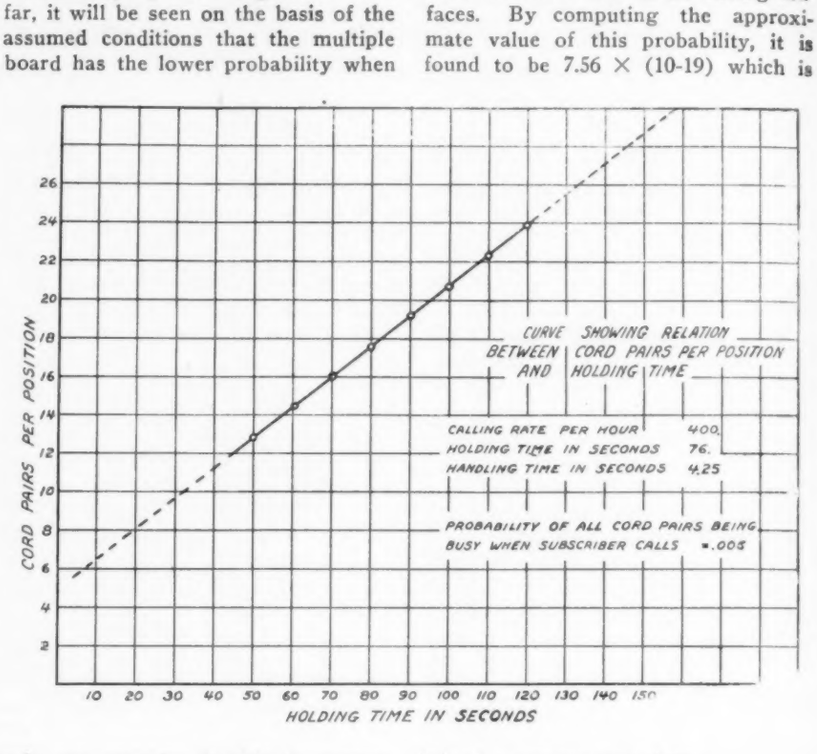
In other words, 5.64 cord pairs would suffice if the entire load were evenly distributed over the entire hour. But as before the same conditions of the subscriber calling at any instant exists. Since there are fifteen cord pairs per position, there must be sixteen calls per position in order that a subscriber must wait in order to complete his call. And furthermore, since the holding time is 88 seconds, each cord pair is capable of being in service 40.9 times per hour. Stating it as a die throwing problem, it is as follows: What is the probability that sixteen aces will be thrown when 230 throws are made with a die having 40.9 faces? By referring to the table, the probability is determined as before, and it is found to be .001—or in other words, once in each thousand calls, all the cord pairs will be busy on this position. And on the basis of 2000 calls per busy hour, this will occur twice times in each busy hour for the entire board.

Effect of Holding Time on Probability

If the holding time in either case is changed, the effect is to cause either an increase in the number of cord pairs to maintain the probability constant or the probability changes with the holding time. Figure 1 shows graphically the effect on the number of cord pairs required when the probability is kept fixed and the holding time is varied. This is seen to be a straight line relation. Figure 1 is computed for the feature board, but a similar curve would apply for the multiple board.

Summing up the argument thus far, it will be seen on the basis of the assumed conditions that the multiple board has the lower probability when only one operator is able to answer the call. But there is another angle to this problem. On a multiple board, the call appears before one operator but also is available to operators on each side of her. Thus the available cord pairs becomes forty-five. In the feature board, the call appears before all operators. In the particular board from which the data were taken there are five, thus making the available cord pairs 85.

On the basis of the entire board, it is analogous in the case of the feature board, to throwing 86 aces when 2000 trials are made with a die having 46.7 faces. By computing the approximate value of this probability, it is found to be 7.56 × (10-19) which is indeed a remote probability.


CORD PAIRS PER POSITION
HOLDING TIME IN SECONDS
CURVE SHOWING RELATION BETWEEN CORD PAIRS PER POSITION AND HOLDING TIME
CALLING RATE PER HOUR 400.
HOLDING TIME IN SECONDS 76.
HANDLING TIME IN SECONDS 4.25
PROBABILITY OF ALL CORD PAIRS BEING BUSY WHEN SUBSCRIBER CALLS .005

For the multiple board, the proposition becomes the probability that 46 aces will be thrown when 690 trials are made with a die having 40.9 faces. By solving for this probability, it is found to be 2.965 x (10-18).

Same Number of Cords Per Position Is Sufficient

The figures just reduced show that for either type of board the probabil-

TABLE NO. 1

Deviation Plus Average	PROBABILITIES .001	.002	.004	.006	.008	.010
	AVERAGE					
1	.001	.002	.004	.006	.008	.01
2	.045	.065	.092	.114	.133	.149
3	.191	.243	.312	.361	.402	.436
4	.429	.518	.630	.709	.771	.823
5	.739	.867	1.02	1.13	1.21	1.28
6	1.11	1.27	1.47	1.60	1.70	1.79
7	1.52	1.72	1.95	2.11	2.23	2.33
8	1.97	2.20	2.47	2.65	2.79	2.91
9	2.45	2.92	3.02	3.22	3.38	3.51
10	2.96	3.26	3.6	3.82	3.99	4.13
11	3.49	3.82	4.19	4.43	4.62	4.77
12	4.04	4.40	4.80	5.06	5.26	5.43
13	4.61	5.0	5.43	5.71	5.92	6.10
14	5.20	5.61	6.07	6.37	6.60	6.78
15	5.79	6.23	6.72	7.04	7.28	7.48
16	6.41	6.87	7.39	7.72	7.97	8.18
17	7.03	7.52	8.06	8.41	8.68	8.90
18	7.66	8.17	8.75	9.11	9.39	9.62
19	8.31	8.84	9.44	9.82	10.11	10.35
20	8.96	9.52	10.14	10.54	10.89	11.08
21	9.62	10.2	10.84	11.26	11.57	11.83
22	10.29	10.89	11.56	11.99	12.31	12.57
23	10.97	11.59	12.28	12.73	13.06	13.33
24	11.65	12.29	13.01	13.47	13.81	14.09
25	12.34	13.00	13.74	14.21	14.57	14.85

ity is practically negligible that a call will be left standing because no cord is available.

On the basis of a total of 2000 calls per busy hour and on operator's load of 400 calls per busy hour, it is necessary to have five positions in the feature board to handle the calls. This gives a total of 85 cord pairs for the entire board. On the other hand, with an operator's load of 230 calls per hour for the multiple board, nine positions would be required, thus making 135 cord pairs for the board. It is evident from the results of this study that there is no necessity of increasing the number of cord pairs per position on the feature board beyond 17 in spite of the increased operator's load in calls per hour and the consequent reduction in number of positions necessary in the office as a whole.

Washington Superintendents Commission Had Power to Authorize Telechronometer

The State Supreme Court of Washington has handed down a decision which clears up certain matters of jurisdiction of the State Department of Public Works in the Everett Telephone case, involving the use of the "Telechronometer." On April 1st, 1922, the Public Service Commission of Washington, now the Department of Public Works, authorized the Puget Sound Telephone Company of Everett to place into effect an experimental schedule of rates based on the telechronometer measuring system. After a trial of several months and a considerable controversy between the telephone company and the city authorities, the department issued an order on September 15th, restoring the flat rate system previously in force. The order provided that subscribers, who had ordered out telephones, might have service restored by paying back bills and disconnect and reconnect charges.

During the controversy, the city had sued for a review of the order establishing a schedule of measured rates and after the final rate order was issued, the department moved the dismissal of the review proceedings on the ground that the controversy was closed. The motion was granted but an appeal was taken by the city on account of the condition imposed in connection with restoration of service. The city's contention that the entire proceeding was unlawful and that the department had no authority to authorize experimental installations and rate schedules was not upheld by the Supreme Court. The decision upholds the authority of the commission to establish experimental rates and to sanction the use of new equipment and methods.

OUR LITERARY DIGEST

Review of Recent Articles on the Telephone and Allied Subjects.

"Transatlantic Radio Telephony," by H. D. Arnold and Lloyd Espenschied. Journal of the American Institute of Electrical Engineers, August, 1923.

This paper is a report of the results of the experiments in voice transmission across the Atlantic ocean which took place in January 1923. Three principal objects of the tests were to discover the effectiveness of newly developed methods of transmission, the effectiveness of improved methods of reception and the transmission characteristics for transatlantic distances. The method of transmission used was the single side-band, carrier system. This system is familiar to those who have been studying the application of high frequency carrier systems to wire lines. In the production of voice-modulated high frequency currents, the energy is distributed in three parts, the carrier frequency itself and two side bands, one above and one below the carrier in frequency. Only one side band is used in reception and therefore the other two parts may be suppressed. A complete description is given in the paper of the transmitting system, showing the means employed in eliminating the carrier and one side band. The final amplifier used had a capacity of 150 kw.

The receiving system was designed for reception of single side-band transmission as the ordinary receiver of radio telephone signals is not adapted to reception of such signals. Among the advantages of the system are the conservation of frequency bands required for radio telephony, reduction of power required, simplification of antenna problem, improvement of stability of transmission and reception and reduction of static interference.

Results of daily reception tests covering a period between January 1st and April 9 are reported. Large diurnal variations were found and evidence of large seasonal variation was discovered. The results indicate that it is desirable to use a wave length longer than 5,000 meters and the tests are being continued to include longer wave lengths.

A Manual of Artificial Respiration, by Capt. G. R. G. Fisher. Published by Stratford Co., Boston.

A concise, easily understood authoritative booklet on resuscitation by artificial respiration. The author gives the details of the various methods in a plain and readily remembered manner, with the "Don'ts" as well as the positive instructions made emphatic.

Electrical Vibration Instruments, by A. E. Kennelly, The Macmillan Company, New York.

The subtitle of this book describes it as "an elementary text book on the behavior and test of telephone receivers, oscillographs and vibration galvanometers." By far the greater portion of the book is devoted to the telephone receiver, and it should prove to be of very great interest to all telephone men who wish to become acquainted with the fundamental principles underlying the art of speech reproduction.

For many years researches on the telephone receiver have been carried on under the direction of the author at Massachusetts Institute of Technology and at Harvard University. Many separate papers have been published in scientific journals but the material has been scattered and the connection between the various portions of the work has not been clear. In the present work, the materials have been collected and arranged and the connecting links supplied so that complete and orderly presentation of the characteristics of the telephone receiver is made.

Most electrical engineers are well trained on the laws of the alternating current circuit but they are not so well acquainted with mechanical vibrating systems. The receiver is an electromechanical device and the mechanical characteristics are explained through analogies between them and the electrical system. So successfully is this done that the electrical engineer reading the text will find a surprisingly small amount of difficulty in understanding the dynamics of the mechanical vibrating system.

A basic idea upon which the presentation is built is the motional impedance diagram. This is a diagram obtained by determining the difference in impedance of the receiver when the diaphragm is allowed to vibrate under an impressed alternating current and when the diaphragm is damped with the same current flowing through the coils. The diagram takes the form of a circle and from it may be determined many of the characteristics of the instrument.

The mathematical difficulty is of about the same order as that of the alternating current circuit and the parts requiring more extended mathematical analyses are placed in the appendices.

This book represents an important contribution to the knowledge of electrical vibration instruments and it should have a place in the library of every technical school and of every electrical laboratory. Every earnest student of the technical side of telephony will want a copy.

Practical Plant Problems

Chapter XVII—"Short-cut" Methods in Emergencies

By CHARLES W. MCKAY, Associate Editor*

The rehabilitation of a telephone property is an expensive proposition—and frequently, in the case of the smaller companies, it is necessary to resort to (what may be termed) "home-made" methods—to reduce costs.

The writer recalls an instance where a telephone company installed an expensive aerial cable distribution system. It so happened that the cable sheath did not contain the right proportion of lead, antimony, etc. Consequently, about a year after the cable was installed portions of the sheath showed marked evidence of "crystallization." Obviously, it was out of the question to replace the cable system at once, and it was necessary to resort to temporary expedients. The manager of the plant was resourceful and evolved the following plan of remedying the trouble.

A number of inspectors—properly equipped with boatswain chairs—were sent out to "ride" the cable. At every point where evidence of crystallization of the sheath was found the inspectors painted the sheath white—supplementing this identification with proper notes as to geographical locations. Subsequently an expert repair man was sent out with instructions to remove all of the sheath sections painted white; boil the cable thoroughly in paraffine and replace the sections removed with split sleeves—these sleeves, of course, being properly soldered to the original cable sheath. In some instances it was not found necessary to remove the original sheath. The portion of the sheath showing evidence of crystallization was thoroughly scraped and subsequently overlaid with a coating of solder or "composition."

The adoption of the plan outlined in the foregoing paragraphs proved remarkably effective. After the repairs had been made it was found that the cable was practically as good as new—although it was necessary to watch it carefully for evidence of additional sheath deterioration.

In another plant—of about the same size as the one just referred to—it was found that a large number of poles showed evidence of rot at the ground line, though in all other respects these poles were in perfect condition. It so happened that it was impossible to reset the poles, and the cost of replacement would have been prohibitive. The manager of this plant evolved a simple, effective, and inexpensive plan of remedying the trouble.

After a careful inspection had been made of all the poles to determine their exact condition—as to rot at the ground line—each defective pole was provided with a concrete reinforcement installed in the following manner:

The earth was removed from around the pole for a depth of several feet. The decayed portion was chopped away with a hatchet and subsequently carefully scraped and painted with a preparation containing creosote. Four U-shaped iron bars (pointed at both ends) were driven into the poles—these bars serving as a reinforcement for the concrete. A removable metal form was placed around the butt of the pole; the concrete poured and allowed to set for about two days. After that time the metal form was removed and the earth replaced. A cross-sectional view of a pole reinforced in the manner above described is shown in Fig. 1.

It was found that the method described in the foregoing paragraph was effective—appreciably prolonging the useful life of the poles, at a relatively small cost.

Other inexpensive "short-cut" reconstruction methods will be discussed in the November issue.

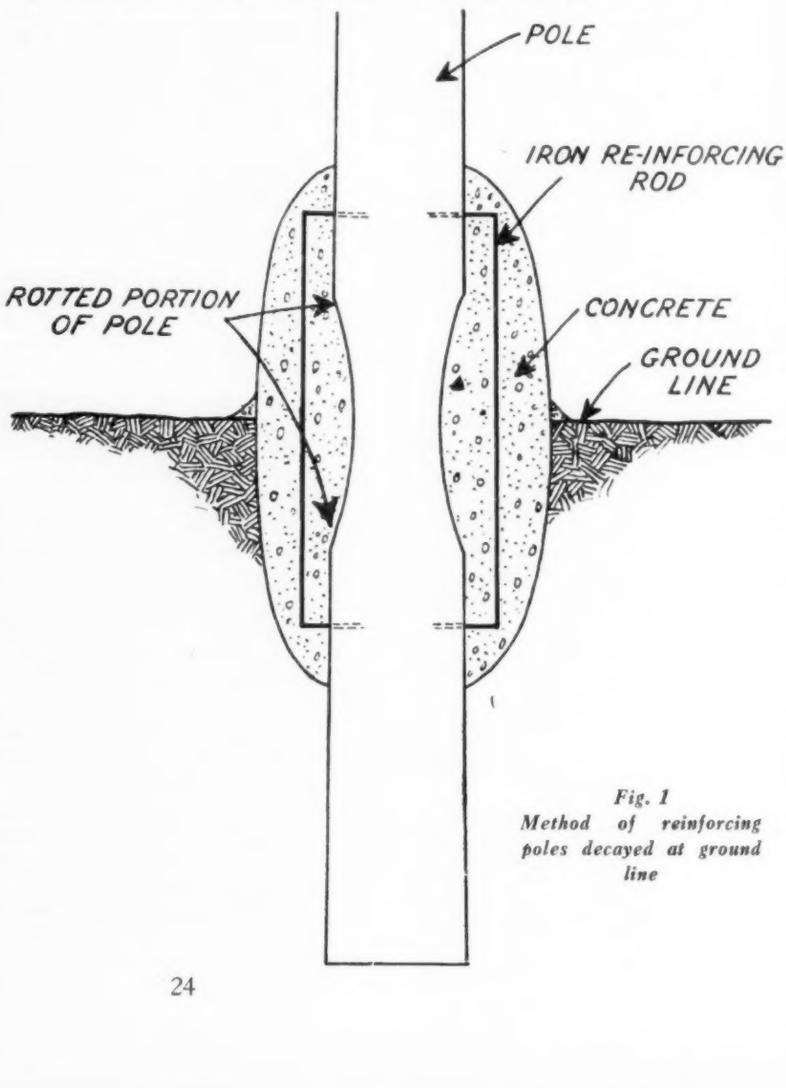


Fig. 1
Method of reinforcing poles decayed at ground line

* *Mr. McKay is manager of the valuation division of the Roberts-Pettijohn-Wood Corporation, 646 North Michigan Avenue, Chicago, and consultant on telephone engineering problems.*

U.S.I.T.A. Plans Great Meet

National Independent Association at Chicago, October 23-26 to Bring Together Big Crowd for Practical Discussions—Traffic to Be Feature—"Vets" on Deck

Chicago, Ill.—When the whistle blows to begin work at the annual convention of the United States Independent Telephone Association at Hotel Sherman, Tuesday, October 23, it will sound in the ears of one of the biggest assemblies of Independent telephone men and women brought together in recent years. That is the opinion of men who have made careful preliminary surveys of the event.

Mornings will be devoted to general sessions and in the afternoons the special meetings will be devoted to such subjects as employes' benefit system, long distance rules, income tax reports and settlements. Financing, sub-station protection and utility policies will be the features of the Wednesday morning session. On Wednesday afternoon traffic will be the headliner, with traffic executives, men and women, meeting for a discussion of their problems.

Thursday will be the rally day for the Pioneers. A business meeting of the veterans will be held, with President H. E. Bradley presiding, and from the luncheon through the afternoon the old timers will frolic, with ample arrangements made for their entertainment by the committee which is headed by Frank Eldridge. The program:

TUESDAY, OCTOBER 23,
10:00 A. M.

Meeting of Board of Directors.

Registration, convention floor.

Opening of exhibits, convention floor.

TUESDAY, 2:30 P. M.

General Opening Session.

Report of President F. B. MacKinnon.

Report of Secretary C. C. Deering.

Reports on employes' benefit system, long distance rules, code of ethics, income tax reports and settlements, etc.

Appointment of committees.

Miscellaneous business.

WEDNESDAY, OCTOBER 24,
10:00 A. M.

General Session, Convention Hall.

Address, "The Texas Plan for Financing Telephone Companies."

Address, "Substation Protection."

Address, "Public Utility Policies."

WEDNESDAY, 1:30 P. M.

Meeting of traffic superintendents, supervisors and chief operators.

Annual election of directors.

THURSDAY, OCTOBER 25,
PIONEERS' DAY,
10:00 A. M.

General session and business meeting. 1:00 P. M.

Annual Pioneers' luncheon and entertainment.

FRIDAY, OCTOBER 26,
10:00 A. M.

Discussion of financing plans, employes' benefit plan, substation protection, procedure and other questions.

Reports of committees.

Miscellaneous business.

FRIDAY, 1:30 P. M.

Annual luncheon and conference of state association executives.

Exhibitors who had reserved space up to October first are given in the list following. There were only two spaces left when this assignment of space was made. Exhibits this year are being staged with special attention to their educational value, so the executive who brings his practical men to the meeting will be able to logically regard the trip as a post-graduate course in telephone engineering.

The exhibitors and their space numbers.

Anaconda Copper Mining Co., booth 12; Acme Card System Co., booth 10; Addressograph Co., booth 1; American Electric Co., room 102; Automatic Electric Co., rose room; Lynton T. Block & Co., room 104; Carbon Products Co., booth 3; Chance Co., booth 4; Coffey System & Audit Co., room 110; Cook Electric Co., room 101; Electric Storage Battery Co., booth 2; First Aid Specialty Co., booth 7; French Carbon & Battery Co., room 107; Harrah Mfg. Co., booth 11; Paul W. Herbst, booth 9; Holtzer-Cabot Electric Co., room 118; Kellogg Switchboard & Supply Co., west room; Leich Electric Co., rooms 116-117; Monarch Telephone Mfg. Co., rooms 114-115; National Carbon Co., room 105; National Cable Compound Co., booth 5; Naugle Pole & Tie Co., room 103; North Electric Mfg. Co., room 112; Page & Hill Co., room 108; Reliable Electric Co., room 106; Runzel-Lenz Co., room 111; Standard Underground Cable Co., room 109; Stromberg-Carlson Tel. Mfg. Co., grey room; Templeton, Kenly & Co., Ltd., booth 6; The Twin Dry Cell Battery Co., booth 8; Con P. Curran Ptg. Co., booth 14.

Illinois Plans Snappy Meeting November 13-15

Peoria, Ill.—Illinois Independent Telephone Association is impressing upon its members that reservations for rooms at the Jefferson Hotel during the Peoria state meeting, Nov. 13-15, should be made at once. A big crowd is expected and a business and entertainment program has been arranged to make the visit worth while.

Illinois District Holds Fine Meeting at Sullivan

Sullivan, Ill.—The first autumn district conference of the Illinois Telephone Association held here recently, was featured by an interesting technical program for the executives and operators. Protection was one of the leading topics of discussion. At a lively banquet J. Paul Clayton of Springfield delivered an absorbing address on public relations. Notables in Illinois telephone circles, among them, Dr. R. E. Gordon, Jay G. Mitchell and C. B. Cheadle, addressed the meeting. An operators' conference was held under the supervision of Miss Marguerite Norris, traffic supervisor of the La Porte (Ind.) Telephone Co., assisted by Miss Ruby Green of the Cheadle-Sterrett interests.

(Continued from page 20)

standstill by applying the brakes is given as follows: Multiply the speed of the car in miles per hour by itself and divide by 10. The result is the number of feet that the car may be expected to travel before it is brought to a full stop if the brakes are in good condition. If the car is moving at 15 miles per hour the rule works out as follows: 15x15=225 and 225÷10=22.5 feet. Thus it may be expected that a car traveling at 15 miles per hour can be stopped in 22 or 23 feet. If the car is traveling at 60 miles per hour we have 60x60=3600 and 3600+10=360. This indicates that it will take more than an average city block to stop a car going at 60 miles per hour, even if the brakes are in first class condition.

This test of the condition of brakes is easily applied if lines are marked off on the pavement 20 feet apart. The car approaches the first line at a speed of 15 miles per hour, just as the line is crossed the brakes are applied full force and the car should come to a stop at the second line.

Hubenthal Quits State Employ for Association

Oklahoma City.—H. W. Hubenthal, for the last seven years telephone engineer of the Corporation Commission of Oklahoma, resigned from that position September 15 to accept appointment as telephone expert for the Oklahoma Utilities Association. He has qualified as an expert in telephone rate controversies in numerous states, during his connection with the Oklahoma commission, and is regarded in the industry as an expert in any of several branches of the business. He has been in telephone work for 27 years and is said to know the game "from the bottom of the hole to the top of the pole." His experience as a manager and with the Corporation Commission has given him both theoretical and practical knowledge of the accounting and office side of the business. In his work with the association he will hold himself available for the service of the telephone company members in connection with any problem that may confront them. It is believed that he will be more valuable to the industry in Oklahoma even than he could be with the Corporation Commission as he will be free to give immediate consideration to any situation demanding investigation and relief, whereas, on account of inadequate appropriation, he could reach but few situations except those arising out of the routine work of the commission's office.

Bernie Richardson, also widely experienced in the telephone business, in recent years a traveling representative of the Stromberg-Carlson Telephone Mfg. Co., succeeds Mr. Hubenthal as telephone engineer for the Corporation Commission. He takes the position at financial sacrifice but because he believes it will broaden his experience, and in order that the advantages of living in Oklahoma City may be afforded his family.

As Mr. Hubenthal and Mr. Richardson will necessarily be closely associated in their work it is believed that the telephone using public in Oklahoma will profit vastly by the new business connection of both. Mr. Hubenthal has always been exceedingly popular with the independent and rural telephone owners and managers in the state.

Max Hosea Buys Control of Morgantown (Ind.) Plant

Morgantown, Ind.—Max Hosea of Indianapolis has bought the controlling interest of the Morgantown Telephone Co., with exchanges at Morgantown and Nashville. Thos. F. Brickley will continue as president.

Bell Taking Over Nez Perce Co.

The Pacific Telephone and Telegraph Co. has filed a request with the Interstate Commerce Commission for authority to take over the Nez Perce Co-operative Telephone Co.'s properties in Lewis and Nez Perce counties, Idaho. The Nez Perce company controls about 1,500 telephones and the Pacific corporation would pay $40,000 in cash and assume its indebtedness.

Japanese Telephone System Ruined

The recent Japanese earthquake practically ruined the telephone system of the island empire, says a cablegram from P. K. Condict, vice-president of the International Western Electric Co., who was in Japan at the time of the disaster.

Sixteen telephone exchanges were destroyed, putting 82,000 telephone lines out of commission, Mr. Condict reports. In addition, thousands of miles of wires were put into discard. Mr. Condict also states that a personal check-up shows that the number of Japanese employes killed when the concrete buildings of the Nippon Electric Co., allied with the International Western Electric Co., crumbled, totaled 99. It was previously reported that 100 had been killed.

Bell Gives $100,000 to Japanese Relief

New York, N. Y.—The A. T. and T. contribution of $100,000 to the American Red Cross for Japanese relief was made through the Bell headquarters, instead of through the local committees in towns where the Bell operates, that the fund be immediately available.

Tokio, Japan.—In the rebuilding of the Tokio telephone system all telephone and telegraph circuits will be placed underground.

New Wire Data Sheet

The Copper Clad Steel Company of Rankin, Pa., has issued another of its sheets of Engineering Data. The present sheet deals with wire for Police and Fire Alarm Circuits. The importance of weatherproof wires are considered in the following order: 1, safety, 2, cost, 3, electrical properties. Tables are given showing relative cost and strength of various types of conductor. The battery voltages required and the resistance of various loops as well as a typical fire alarm circuit are given, as are also data on splices and tie wires. This data sheet as well as others of the series which have been published previously may be secured upon application to the company.

W. B. Scruggs Heads Missouri Sixth District

Warrensburg, Mo.—W. B. Scruggs, Harrisonville, was elected president of the Sixth District, Missouri Telephone Association, at its meeting held here. Other officers elected were: M. L. Golloday, Holden, vice president, and Shields R. Smith, Sedalia, secretary-treasurer. Among the practical addresses made at the meeting were: "Application of Toll Rates to the Public," by S. M. Hardaway, division state traffic chief of the Bell at Kansas City; "Increasing Efficiency in Telephony," by Barbara Schultz, of the Kansas City Telephone Co., and "Efficiency Applied to Traffic, Commercial and Technical Telephony," by W. T. Friganza, of the Bell at St. Louis.

Purdue Announces Short Telephone Course

Announcement has been made that the date of the Fifth Annual Short Course in Telephone Practice at Purdue University has been set. The course will start November 20 and will continue for four weeks. The course is open without charge to residents of Indiana. The complete details will be given out within a few days.

U. S. Association Files Depreciation Brief with I. C. C.

The United States Independent Telephone Association has filed with the Interstate Commerce Commission a brief, setting forth the attitude of the association in the question of regulation by the commission of depreciation rates and practices of Independent telephone companies. The brief was prepared by C. B. Randall, of Saint Paul, Minn., and Harold L. Beyer, of Grinnell, Iowa. It reaffirms the position taken by the association when its original brief was filed in June, 1921, and supplies legal citations in support of its contentions. Copies have been mailed to all member companies of the association. Others interested in the matter may secure information by writing to F. B. MacKinnon, president of the association, at the Chicago office.

Henry, S. D.—Henry Union Telephone Co. has bought an exchange building and plans extensive improvements.

HELP WANTED

$250.00 each per month for two first class, experienced, specification switchboard engineers. Key No. 1246, care of Telephone Engineer, 28 E. Jackson Blvd., Chicago.

Small Automatic Exchanges

An Article Discussing Further the Application of Modern Automatic Switching in Small Exchanges. Two New Switches, the "Companion-Work" Switch and the Time-Zone-Switch

By F. J. Dommerque and Erwin Gendriess

In a recent issue of a New York daily paper the following brief notice appeared:

Automatic Phone Registers Charges

"What is said by a writer in the Berliner Tageblatt to be the first automatic long-distance telephone that not only gives the patron the desired connection without the aid of the 'hello girl,' but also keeps track of the cost of the conversation and registers it on the user's bill, is in operation between two towns in Upper Bavaria. All Munich has been equipped with automatic phones for some time at an estimated saving of about $100,000 a year in wages, and the system is being rapidly extended. Unfortunately," remarks the Tageblatt writer, "the absolutely automatic long-distance service cannot be pushed very far, as the mechanism becomes too complicated, so a certain amount of help has to be given by a few operators."

It will be of interest to explain the method of doing away with the toll ticket and its accompanying bookkeeping, referred to in above note, all the more because the explanation will at the same time illustrate a modern type of small automatic exchange, such as had been advocated in the August number of the TELEPHONE ENGINEER by one of the writers.

This installation is not far from Munich and comprises at the present time a small town (Weilheim) and two villages (Huglfing and Polling). The initial number of subscribers in the district is only 300. The town exchange is the largest of the three in the district and has been chosen as the center where are located the first and second selectors or group switches, while the villages contain only the line and connector-switches, which naturally belong together. Of course the town exchange has besides the group switches the line switches and connectors for its local subscribers.

It is assumed that the reader is familiar with the rudiments of automatic operation and the general makeup of the switches used therein.

The accompanying Fig. 1 presents an outline of the district arrangement. The three circles represent the three exchanges. The circles for Weilheim and Huglfing contain their equipment, while the circle for Polling is left blank, its equipment being identically the same as the Huglfing exchange. Each line in the sketch represents a metallic circuit. The trunk lines between line and group switches, and between group switches and connectors are two-wire trunks, which is of importance, as it contributes to economy. In most cases where all switches are located in one and the same building, three-wire trunks are used. The transmitter current is provided by the local battery. In the figure, switches of the rotary or one-motion type are identified by the wiper and one segment; switches of the vertical and rotary or two-motion type by the wiper and two segments.

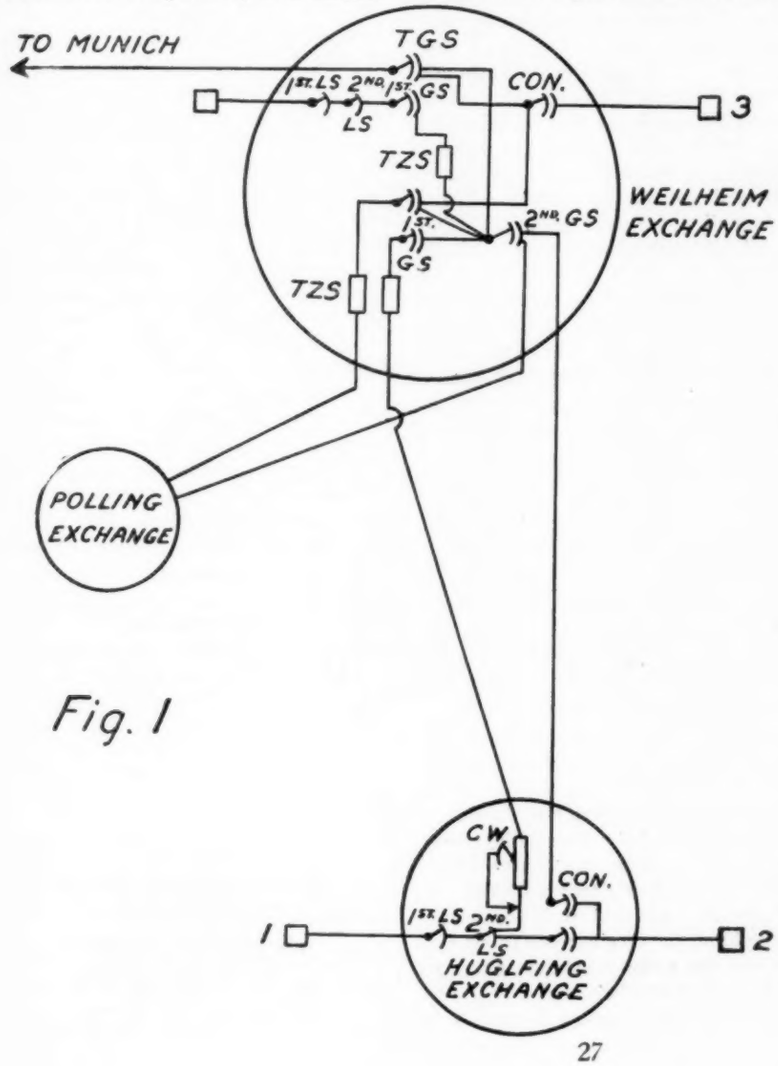


Fig. 1

We now proceed to the explanation of the method of operation, commencing with the Huglfing exchange, which in this system constitutes a subexchange. Ordinarily an automatic subexchange is characterized by the circumstance that it contains no group switches and that all its calls, including local calls, pass through group switches located at the central exchange into which the subexchange works. Therefore, when subscriber 1 (see figure) desires to call subscriber 2, he will remove his telephone from the hook, whereby his line switch or line switches operate (there may be first and scond line switches to economize on trunks) and select a trunk to an idle first group switch at the central exchange. Then he manipulates his dial, whereby the first group switch at the central selects trunk to an idle second group switch also located at the central ex-

change. The operation of the second group switch connects the calling subscriber to an idle connector at the originating exchange and through it to the desired subscriber 2.

If the call would have been for subscriber 3 in the central exchange, it would have been extended from the second group switch at the central, directly to an idle connector in the same exchange. It will be seen that a local Huglfing call has to go through the Weilheim exchange and thus occupy two comparatively long trunk lines, which has been a disadvantage to such systems. In the new layout this is avoided by the introduction of a "companion work" CW at the originating exchange, consisting of a rotary switch and a set of relays. This companion work is inserted at the local end of the trunk line from the subexchange to the first group switch at central and responds to the impulses sent from the dial of the calling subscriber, the same as group switches do. Every exchange in the system has in its number a digit indicative of the exchanges in the district. When subscriber 1 operates his dial and pulls the digit indicative of the desired exchange, the companion work follows the impulses. If the call is a local call and the wiper of the companion work reaches the contact indicative of the home exchange, a relay will be operated which causes the second line switch to continue rotation. Thereby a disconnection is caused of the trunkline to central and a direct connection made to a connector in the home exchange provided especially for such local calls; only in case all these special connectors are busy, will the call be directed through the central exchange. Thusly we are made acquainted with a device which greatly contributes to the efficiency of automatic operation of small exchanges, namely, the companion work.

Casually, it may be mentioned that a toll or long distance call to or from a distant toll board passes through a toll group switch (TGS in the figure), the nearest toll board in this case being Munich.

Where calls from the district go through already existing toll boards, no change is made in the method of recording the toll charge from the one in use at the toll board, but for all toll charges inside of the territory where the desired party can be reached over lines not passing through a toll board already in existence, a zone system of charging is employed, which is based upon distances. The central exchange of a district is made the origin of the zone system. All subscribers in the entire system are measured rate subscribers and are provided with call meters. As explained in the August number, there are no party lines, which makes things easier.

The rate charged for a local call is fixed as unit for all charges, local and toll. In the first zone, which extends three miles all around the district central, only the unit charge is made regardless of the duration of the call. The next zone reaches from the three-mile to the nine-mile limit. For calls to subscribers in this zone the charge for a 3-minute conversation is three times the unit charge, and for a 6-minute conversation $2 \times 3 = 6$ times the unit charge. The third zone is between the 9-mile limit and the 15-mile limit. The charge for a 3-minute conversation is then 5 times the unit charge and for a 6-minute conversation $2 \times 5 = 10$ times the unit charge, and so on.

The following is the method by which the zone and time charges are recorded automatically: As the figure shows, time-zone-switches (TZS) are inserted at the district central in the central end of each trunk between exchanges. The zone-switch part is a rotary switch with its associated relays similar to the companion work. When a subscriber makes a toll call he sets the indicative number to operate the group switch; the zone-switch responds also to the impulses and stops its wiper to the contact, fixing the fundamental charge of the zone wherein the desired subscriber is located. This contact is connected to the time-switch which consists of two rotary switches. The one of these is actuated by a clock, stopping the switch once for each 10 seconds. After 18 steps, that is, after 3 minutes, the second one is actuated by the first one and takes one step. Thereby certain contacts of a fourth rotary switch, the "computer," is engaged in such a manner that the engaged contact is the third or sixth, according to the length of conversation for the second zone or the fifth or tenth for the third zone. In this way zone and time are registered upon the computer. After the conversation is terminated and the calling subscriber hangs up, the computer commences to rotate until its wiper comes upon the contact engaged by the zone-time switch. After this normal condition is restored.

Each time the computer takes a step the callmeter of the calling subscriber receives an impulse, whereby it is advanced by one unit; then the charge for the call is recorded. The calling subscriber can ascertain the charge registered if he presses down by hand the switchhook at the end of the conversation, holding the receiver still to his ear. For each step the callmeter takes, he will hear a short click.

Instead of announcing to the subscriber on a toll call when the 3 minutes are up, as it is the custom in manual practice, he is given a tone 10 seconds before the 3 minutes have elapsed. If he does not hang up at the end of the 3 minutes he is given a second different tone, indicating that the 3 minutes are over. To continue conversation he must set up his call again. There is another feature connected with this novel system of operation. Should the calling subscriber find out, after he has obtained his connection, that he has made a mistake, he can prevent the meter from registering by immediate replacement of the receiver upon the hook, for the computer has not had sufficient time to act, a few seconds' leeway being allowed; but the subscriber must be alert before it is too late.

The above description of a small exchange district indicates the versatility of ways and means available to give the rural subscriber the advantages of new inventions and modern methods. Economy is surely to follow, once the country exchange is revolutionized.

Telephone Meetings at Enid and Woodward

Oklahoma City.—Managers and employees of telephone companies of northwestern Oklahoma met at Enid on October 2 and at Woodward, October 3. These are the last of the district telephone conferences for 1923 held under the sponsorship of the Oklahoma Utilities Association with headquarters at Oklahoma City. At the Enid meeting Mayor John Carr made the address of welcome, response being made by Jack Walton of Broken Arrow, formerly of Enid, chairman of the Telephone Division of the Oklahoma Utilities Association, and at noon luncheon held in connection with the conference, Judge C. F. Dyer presided. A feature of the meeting was an address on "Commercial Problems" by M. M. Flickenger of Kingfisher.

At Woodward the address of welcome was made by Honorable R. O. Renfrew, Mayor, and the toastmaster at the noon luncheon was J. L. Pope, secretary of Chamber of Commerce. The response to the address of welcome was made by E. F. McKay, manager of the Oklahoma Utilities Association, who was for three years the editor of a newspaper at Woodward. F. C. Tyler, of Guymon, is chairman of the Woodward district.

U. S. INDEPENDENT TELEPHONE ASSOCIATION CONVENTION
October 23 *to* 26

Short Period Forecasts

General Description of the Analysis of a Community to Show Present Market and the Estimate of Growth of Telephone Service Over a Short Period

By Perry W. Smith and R. E. Shook
Commercial Engineering Department, Indiana Bell Telephone Co.

In the preparation of short period forecasts of five year studies, practically the same consideration but to a lesser degree is given the city or territory regarding general characteristics, such as industrial, commercial and residential features as in the preparation of long time surveys. In the preparation of a short period study however, it is not necessary to go into as much detail regarding the probable changes in the characteristics of a particular section of a city for the reason that there is less probability of a residential section changing within a short time to a strictly industrial section. Homogeneous divisions are considered and these are made the major divisions on the field maps. Short period studies are made for the purpose of determining to what extent additional facilities are required and for any extensive replacement or rearrangement of plant in a given section.

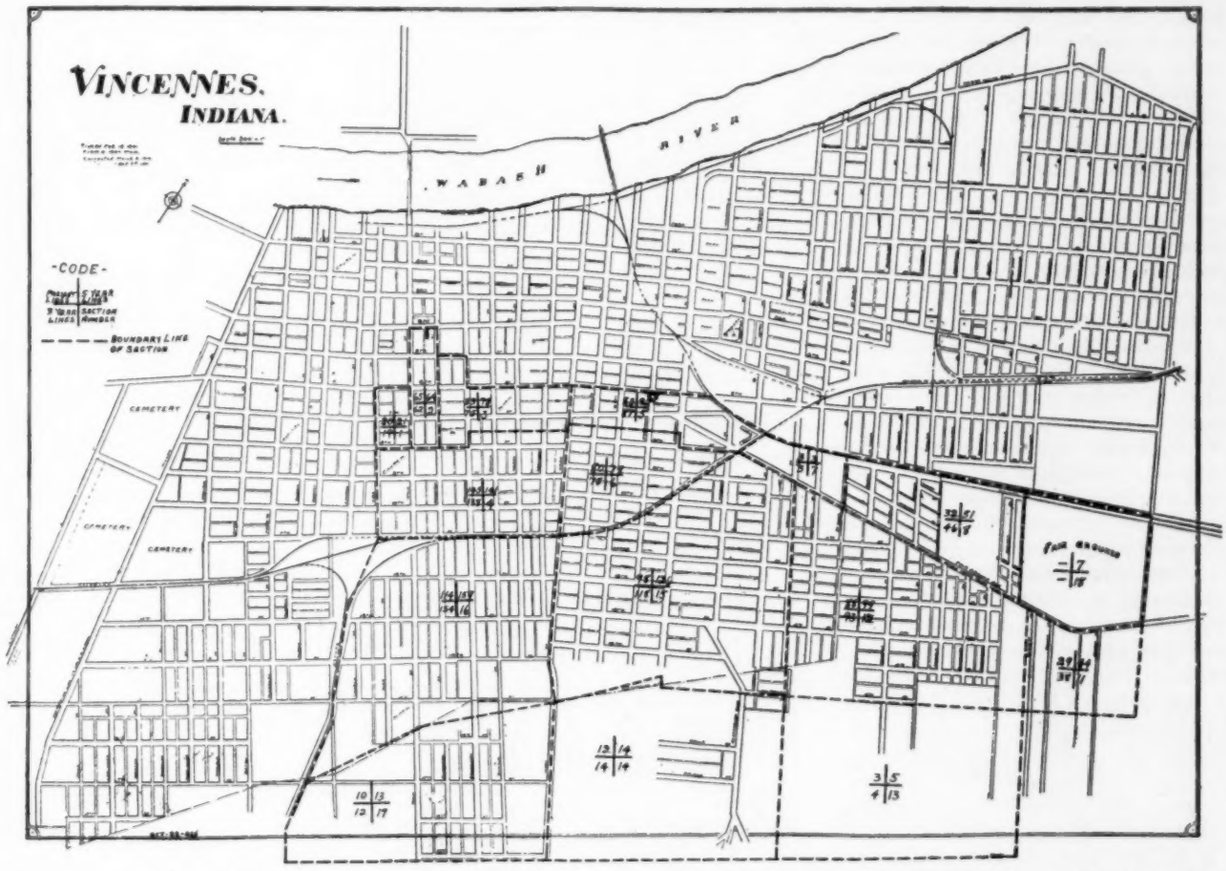
House Count Sections

In outlining house count sections, more consideration is given to the layout of the present cable plant than in long time study. It is not probable that the entire outside cable plant will be changed within five years and for this reason estimates of growth should be shown for sections which can be easily compared to the facility situation of the present plant. For the purposes of comparison, the same house count sections should be used whenever future studies covering the same territory are made.

Count and Classification of Families and Firms

Each dwelling in the community is identified by street address, then classified on tally sheets, as an A, B, C or D residence according to its rental value. The method for determining the classification of dwellings according to their rental value is explained in Commercial Department Instruction No. 6, Supplement to Sheet No. 4, which is shown with this article as Figure 1. After the house count has been completed the entries on the tally sheets are summarized and compared with a list of the present subscribers by addresses. By this method the nonusers which comprise the potential market are identified.

The classification of vacant lots depends upon the adjacent territory and the adaptability for residence or business construction. Careful tally is made of all such lots and the data is used in estimating development. Business places are classified as X, Y or Z, small, medium or large, and the users and non-users are identified in the same manner as in the residence section.



*Reprinted from Bell Telephone News.

The most economical mode of transportation is used in making the house count, both sides of a street can be taken at one time and as the field man has at hand a map of the section which is being covered, streets can be checked off and notes made on the map as the work proceeds. In the business section the tallying must be done on foot, as a closer inspection of premises is necessary to determine addresses and to locate residences over business places. It is not assumed that family dwelling places in the business section will increase, rather there will be a reduction in the number of these premises as the older buildings are replaced. Every reliable business is listed as a potential telephone user, practically the only exceptions being shining parlors, very small retail shops and wagon lunch stands.

In the smaller cities in this territory usually no great expansion is looked for in the business section. As a rule cities up to 20,000 population have their downtown district around the courthouse or public square and whatever changes take place will be either in or immediately adjacent to the present business section. The number of drug stores, groceries and retail establishments usually are proportionate to the population of the city and to the adjacent suburban and rural territory. In estimating development this fact must not be overlooked. The population will only support a certain amount of business and increases in business establishments must be gauged according to the increase in population which in turn depends upon industrial and market conditions. A substantial increase distributed over the entire suburban and rural area will create a demand for more sources of supply in the city proper while an increase confined to a small area will more likely form the nucleus of a community center with corresponding business establishments necessary to its support.

Summarizing the Field Work

When all the families and business establishments in a community have been classified, including those in the territory outside the corporation line or base rate area but within the immediate vicinity of the city proper, the next step is the preparation of various summaries. The data from the field sheets is transferred and summarized under the following heads:

Present firms by sections and present families by house count sections, Form No. 1302. (Form shown in figure 2.)

Present firms and families by sections, arranged as to non-users and users; the latter classified according to the kind of service furnished, Form No. 1303-2A.

Estimate of residence telephone development by house count sections, Form No. 1304. (Shown in figure 3.)

Estimate of business telephone development by sections.

Present firms, downtown section.

Summary of neighborhood firms and vacant business places by house count sections.

Tabulation of the present number of working lines in each city block, summarized by house count sections, Form No. 1306.

Estimating Growth in Population

Only in cases of unusual industrial activity is there any deviation made from the average normal growth of the city for the period covered by the commercial study. One of the methods of checking the growth is by a comparison of past performance of different cities of like size and character over a number of years with the growth for the same period for the city in which the study is being made, also consideration is given to the present possibility for increase in population, advantages or disadvantages of that particular territory which would affect the growth.

Effect of Rate Adjustment

Adjustment of rate levels and the probable effect thereof upon station development and the distribution of the different classes of service is given consideration. Any appreciable change in rate differentials for various classes will serve to cause a regarding of the classes of service, thereby affecting the number of lines. Also where facilities have been lacking and subscribers have temporarily taken a lower grade of service than desired, some regrading upward is assumed will take place after facilities have been provided.

Estimates of Station Development

In estimating station development the present market is considered first. Steps are taken to determine whether or not it is fully developed and if not, the reason therefor, whether facilities are available or if the public is not demanding service to the extent of the market on account of poor industrial or market conditions. The probable

COMMERCIAL DEPARTMENT INSTRUCTIONS NO 6
SUPPLEMENT TO SHEET NO 4

CLASSIFICATION

THE FOLLOWING TABLE QUOTES THE RENTAL FIGURES USED AS A BASIS FOR CLASSIFYING THE VARIOUS DWELLINGS AND ALSO THE CLASSIFICATION APPLIED TO BUSINESS PREMISES:

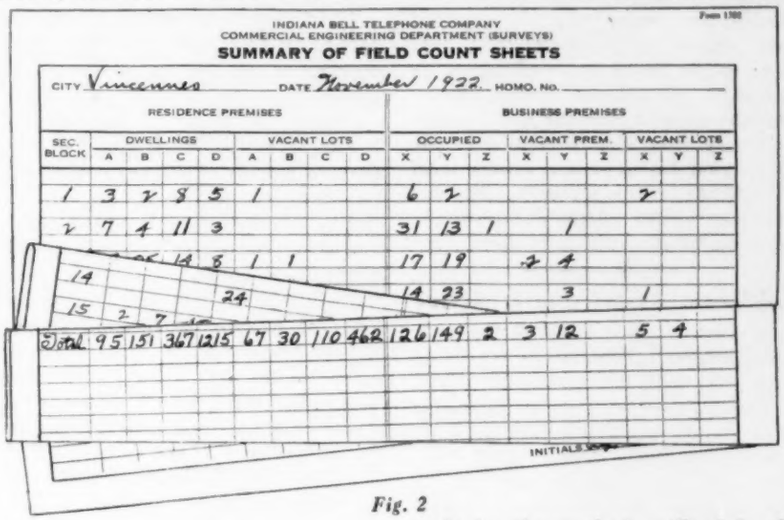
CLASS	DERIVATION	NO. OF LINES TO EACH POSSIBILITY	CHARGING CIRCUITS TO EACH POSSIBILITY	CLASS OF SERVICE	REMARKS
A-RESIDENCE	PROPERTY-$8000 UP RENT $70 UP	1		1 PTY	SERVICE IN EVERY CASE
B-RESIDENCE	PROPERTY $5000 TO $8000 RENT $35 TO $70	1 AND 6		1 AND 2 PTY	SERVICE IN EVERY CASE
C-RESIDENCE	PROPERTY $2500 TO $5000 RENT $25 TO $45	8 AND 166		2 AND 4 PTY	SERVICE IN 2 OUT OF 3
D-RESIDENCE OR TENEMENT HOUSE	PROP. UNDER $2500 RENT LESS THAN $25	166		4 PTY	1 STA FOR EVERY 6 PROSPECTS
HOTEL		05	10	P B X	SERVICE IN EVERY CASE
APARTMENT HOUSE				1 OR 2 PTY RES. DEPENDING UPON CHARACTER OF NEIGHBORHOOD	
X-BUSINESS (ORDINARY)		1.0		1 PTY	SERVICE IN EVERY CASE
Y-BUSINESS (SMALL)		.3		2 PTY	SERVICE IN EVERY CASE
Z-BUSINESS (LARGE)		33	.40	P B X	SERVICE IN EVERY CASE MINIMUM OF 2 LINES

NOTE: THESE VALUES ARE VARIABLE DEPENDING ENTIRELY UPON THE SIZE OF THE COMMUNITY, LOCATION AND CHARACTER OF STUDY AREA. A CLASS "A" DWELLING IN A SMALL TOWN MAY BE CLASS "B" OR "C" IN A LARGE CITY, OR FREQUENTLY IN THE SAME CITY IT WILL BE FOUND THAT THE RENTAL VALUES WILL DIFFER BETWEEN SECTIONS.

Fig. 1

saturation figure is determined by careful study of the characteristics of the families comprising the community, then the period when this saturation figure will be reached. It is not likely in many cases that a town will reach its ultimate telephone development within five years and as no figures beyond six years are shown in short period studies, the percent saturation to be attained at the end of this period is determined by the chart method, using the development for past years up to the present as a basis for projecting forward until the saturation point is reached, then taking from this curve the point of saturation at the end of the short period.

By saturation is meant the number of main line residence telephones per 100 families. To arrive at this figure the stationary population of a city is determined and to this is applied a factor obtained from the U. S. census for the particular city indicating the number of persons per family. When the number of families has been obtained the figure is then divided by the number of main line residence telephones, thus obtaining the saturation figure. Analysis of the results of the house count and the present telephone market will show whether or not the saturation figure is high enough and the estimate of ultimate development is made by the method outlined in the above paragraph.



INDIANA BELL TELEPHONE COMPANY
COMMERCIAL ENGINEERING DEPARTMENT (SURVEYS)

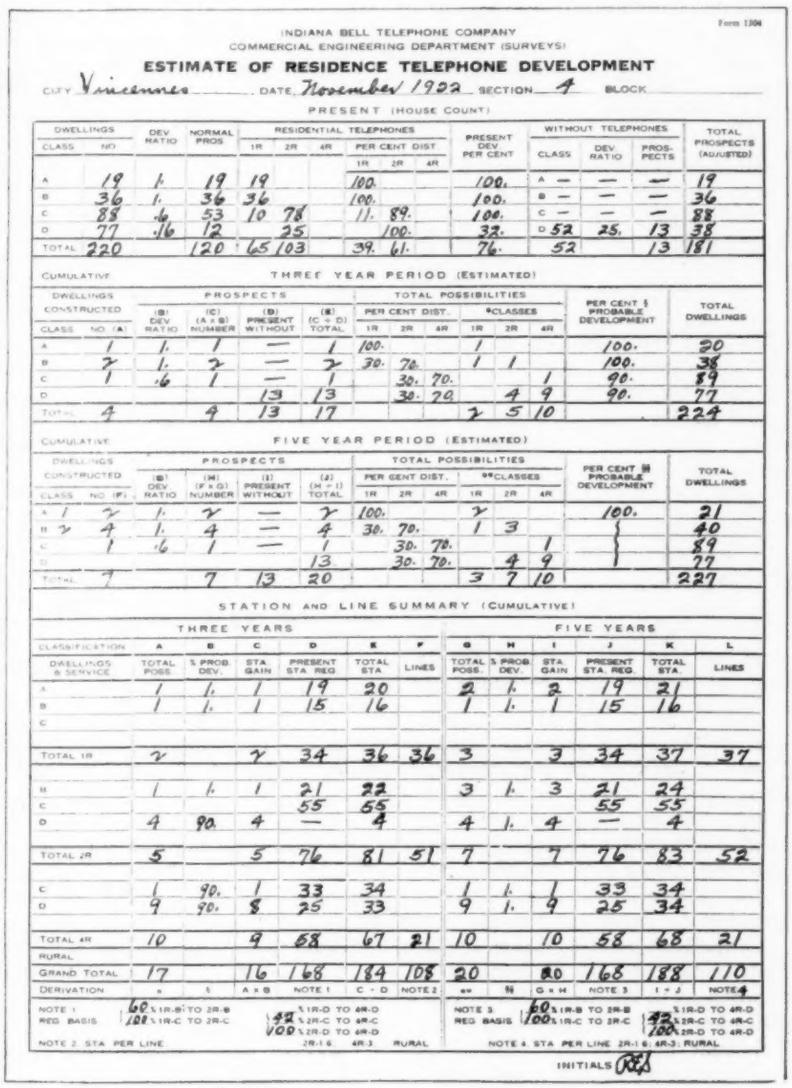
SUMMARY OF FIELD COUNT SHEETS

CITY Vincennes DATE November 1922 HOMO. NO.

SEC. BLOCK	RESIDENCE PREMISES: DWELLINGS A	B	C	D	VACANT LOTS A	B	C	D	BUSINESS PREMISES: OCCUPIED X	Y	Z	VACANT PREM. X	Y	Z	VACANT LOTS X	Y	Z
1	3	7	8	5	1				6	2					2		
2	7	4	11	3					31	13	1		1				
			14	8	1	1			17	19		2	4				
14									14	23			3		1		
15	2	7		24													
Total	95	151	367	215	67	30	110	462	126	149	2	3	12		5	4	

INITIALS

Fig. 2



INDIANA BELL TELEPHONE COMPANY
COMMERCIAL ENGINEERING DEPARTMENT (SURVEYS)

ESTIMATE OF RESIDENCE TELEPHONE DEVELOPMENT

CITY Vincennes DATE November 1922 SECTION 4 BLOCK

PRESENT (HOUSE COUNT)

CLASS	DWELLINGS NO.	DEV. RATIO	NORMAL PROS	RESIDENTIAL TELEPHONES 1R	2R	4R	PER CENT DIST 1R	2R	4R	PRESENT DEV PER CENT	WITHOUT TELEPHONES CLASS	DEV. RATIO	PROSPECTS	TOTAL PROSPECTS (ADJUSTED)
A	19	1.	19	19			100.			100.	A —	—	—	19
B	36	1.	36	36			100.			100.	B —	—	—	36
C	88	.6	53	10	78		11.	89.		100.	C —	—	—	88
D	77	.16	12		25			100.		32.	D 52	25.	13	38
TOTAL	220		120	65	103		39.	61.		76.	52		13	181

CUMULATIVE — THREE YEAR PERIOD (ESTIMATED)

CLASS	DWELLINGS CONSTRUCTED NO. (A)	PROSPECTS (B) DEV. RATIO	(C) (A x B) NUMBER	(D) PRESENT WITHOUT	(E) (C + D) TOTAL	TOTAL POSSIBILITIES PER CENT DIST. 1R	2R	4R	%CLASSES 1R	2R	4R	PER CENT § PROBABLE DEVELOPMENT	TOTAL DWELLINGS
A	1	1.	1	—	1	100.			1			100.	20
B	2	1.	2	—	2	30.	70.		1	1		100.	38
C	1	.6	1	—	1		30.	70.			1	90.	89
D				13	13		30.	70.		4	9	90.	77
TOTAL	4		4	13	17				2	5	10		224

CUMULATIVE — FIVE YEAR PERIOD (ESTIMATED)

CLASS	DWELLINGS CONSTRUCTED NO. (F)	PROSPECTS (B) DEV. RATIO	(H) (F x G) NUMBER	(I) PRESENT WITHOUT	(J) (H + I) TOTAL	TOTAL POSSIBILITIES PER CENT DIST. 1R	2R	4R	%CLASSES 1R	2R	4R	PER CENT § PROBABLE DEVELOPMENT	TOTAL DWELLINGS
A	1	1.	2	—	2	100.			2			100.	21
B	2	1.	4	—	4	30.	70.		1	3			40
C	1	.6	1	—	1		30.	70.			1		89
D					13		30.	70.		4	9		77
TOTAL	4		7	13	20				3	7	10		227

STATION AND LINE SUMMARY (CUMULATIVE)

CLASSIFICATION	THREE YEARS A TOTAL POSS.	B % PROB. DEV.	C STA. GAIN	D PRESENT STA. REQ.	E TOTAL STA.	F LINES	FIVE YEARS G TOTAL POSS.	H % PROB. DEV.	I STA. GAIN	J PRESENT STA. REQ.	K TOTAL STA.	L LINES
A	1	1.	1	19	20		2	1.	2	19	21	
B	1	1.	1	15	16		1	1.	1	15	16	
C												
TOTAL 1R	2		2	34	36	36	3		3	34	37	37
B	1	1.	1	21	22		3	1.	3	21	24	
C				55	55					55	55	
D	4	90.	4	—	4		4	1.	4	—	4	
TOTAL 2R	5		5	76	81	51	7		7	76	83	52
C	1	90.	1	33	34		1	1.	1	33	34	
D	9	90.	8	25	33		9	1.	9	25	34	
TOTAL 4R	10		9	58	67	21	10		10	58	68	21
RURAL												
GRAND TOTAL	17		16	168	184	108	20		20	168	188	110
DERIVATION	a	b	A x B	NOTE 1	C - D	NOTE 2	ee	ff	G x H	NOTE 3	I + J	NOTE 4

NOTE 1 REQ. BASIS: 60/100 §1R-B TO 2R-B; §1R-C TO 2R-C; 42/100 §1R-D TO 4R-D; §2R-C TO 4R-C; §2R-D TO 4R-D

NOTE 2. STA. PER LINE 2R-1.6 4R-3 RURAL

NOTE 3 REQ. BASIS: 60/100 §1R-B TO 2R-B; §1R-C TO 2R-C; 42/100 §1R-D TO 4R-D; §2R-C TO 4R-C; §2R-D TO 4R-D

NOTE 4. STA. PER LINE 2R-1.6 4R-3 RURAL

INITIALS

Fig. 3

Estimate of Subscriber Lines

The number of circuits required to furnish service for the stations in each house count section is determined by applying a loading factor to stations of each class. Where additional multiparty service is introduced an actual reduction in the number of lines may result.

Commercial Forecast

After development figures have been worked out on forms No. 1304 and No. 1305 then summarized on form No. 1306, this detail is transferred to form No. 1310, Commercial Forecast of Stations and Lines and copies of this form forwarded to the Plant, Traffic and Engineering Departments. The Engineering Department is also furnished with a white print map of the territory covered by the study on which sections are outlined and the number of subscribers' lines are shown for the present, three and five year periods. From the detail on this map the outside plant requirements such as feeder cables by sections are determined and plans for construction made accordingly.

Estimates of growth made in connection with short period surveys are based on market figures, in other words, not the number of stations which will actually be installed, but the number which we could install provided facilities were ample. This gives the Plant and Engineering Departments a figure to set up as a limit for which facilities must be provided and enables them to plan extensions as the market is taken up.

The importance of a short period forecast lies in the fact that it provides data for engineering facilities neces-

sary for immediate relief, also a basis on which to determine the advisability from a commercial viewpoint of making extensions in particular sections. Where a long period study has previously been made, the short period study should, in a general way, conform to the trend of development as shown by the ultimate figures. However the growth over the short period may vary from the average over the long period due to various causes, local or national, affecting the market for telephone service or the ability of the company to serve all applicants.

California Association Is Active

Activities of the California Independent Telephone Association are being expanded rapidly since the employment of Ernest Irwin of Pomona as Secretary. A number of new member companies have been added since 1921, when the Association extended its field to cover the whole state. The Secretary has been assisting a number of companies in appraising their properties and in cases before the California Railroad Commission. He has also been assisting with advice in connection with plant extensions for some of the companies. Every month a letter filled with live information is sent out to keep the companies advised as to what is being done by the Association and Associations in other states. Activities of member companies and important court and commission decisions are also included. The Executive Committee has at the present time under consideration a "financing plan" for independent companies, but as yet has no definite information to give out. For the support of the Association, each member pays an assessment based on its gross revenue. Ordinarily this is one-eighth of the gross revenue at a time and not more than one-half of one percent during any calendar year. The maximum that has been levied in any one year is one-fourth of one percent.

Expect Completion of St. Louis Merger by June 1, 1924

St. Louis, Mo.—Merger of the Kinlock system with that of the Bell will be completed here about June 1, 1924, authorities estimate. Almost $3,000,000 will be spent during 1924 in completing the merger. Automatic equipment is to be installed in two downtown exchanges. The Bell estimates an increase of 93,000 telephones in St. Louis during the next five years.

Montreal, Canada, will have its first dial telephones in use at the end of 1924, with the completion of a new machine switching central office costing, $1,500,000.

Indiana Convention

General Staff of Experts Among Many Features Discussed

The Convention Season of 1923 was opened on September 19 and 20 by the meeting of the Indiana Telephone Association at Indianapolis. An address by Henry A. Barnhart of Rochester, President of the Association, was the opening feature of the convention. Mr. Barnhart's address dealt with the necessity of good service and the obligation of the telephone company to give it and of the public to pay for it. Weak spots in long distance and local service must be cleared up through friendly and helpful influence rather than by orders of the Public Service Commission. Following the President's address, came the reports of officers and the appointment of committees. F. B. MacKinnon of Chicago, President of the United States Independent Telephone Association, was the principal speaker of the Wednesday afternoon session. Mr. MacKinnon's topic was a subject that has recently been under discussion among telephone men, namely, the formation of a general staff of experts whose services would be available to companies of the independent group. Mr. MacKinnon pointed out the fundamental difference in organization between the independent industry and the American Telephone and Telegraph Company. A staff of experts in the independent field could advise and prescribe methods, but could not enforce them. The class A companies have their own staffs and a general meeting may be called to discuss the possibility of a more closely knitted organization for this type of service.

Governor Edwin P. Morrow of Kentucky, was the speaker at the banquet, held Wednesday evening, in the Riley room of the Claypool Hotel. Governor Morrow paid a tribute to the telephone industry and deplored the attitude of people who begrudge the pay for the service rendered.

At the Thursday morning session, Stephen M. Isom of Mitchell, discussed the method of laying cable without conduit, but with a protective compound which will prevent corrosion. Following Mr. Isom, President Edward C. Elliott of Purdue University, addressed the convention on the relation of the University to industry. Dr. Elliott indicated the resemblance of the problems of education and of communication in developing a similarity of thought and purpose among the citizens of the nation. He spoke of the work of the University among the farmers of Indiana and the plans for extending the work among the industries.

Among other features of the program were talks by the presidents of the six district associations on the work done in their districts and a discussion of public relations and publicity by John C. Mellett, secretary of the Indiana Public Utilities Association, George B. Wellbaum, publicity director of the Indiana Bell Telephone Company and E. L. Gaines of the Home Telephone and Telegraph Co., of Fort Wayne.

Four retiring directors, F. O. Cuppy of Lafayette, F. V. Newman of La-Porte, S. M. Isom of Mitchell, and W. W. Harbaugh of Sullivan, were re-elected. Out of respect of his memory, no director was elected to succeed the late W. M. Bailey of Richmond.

Houston District Approves Texas Finance Plan

Houston, Tex.—A well attended meeting of the Houston district of the Texas Independent Telephone Association went on record as being heartily in favor of the financing plan outlined by Judge S. A. Lindsay, and the work which has been done by the committee appointed to carry out the work. The meeting was well attended and was shown several interesting exhibits of equipment by leading manufacturers.

The program furnished a well balanced schedule of practical and inspirational features. On this program:

"Public Relations." George McQuaid, director, Texas Public Service Information Bureau, Dallas.

"What Are Adequate Rates?" G. B. Foscue, general agent, The Texas Telephone Co., Waco.

"Alibis." J. C. Paxton, assistant general manager, The Grayson Telephone Co., Sherman.

"Financing Independent Telephony in Texas." Judge S. A. Lindsay, president, Gulf States Telephone Co., Tyler.

"The Relations of Proper Accounting to Business." F. M. Moore, auditor, The Texas Telephone Co., Waco.

"What You Should Know About Storage Batteries." C. D. Kinne, Texas representative, Stromberg-Carlson Telephone Mfg. Co., Dallas.

"Up-to-Date Methods of Clearing Trouble." S. B. Dibble, equipment engineer, The Texas Telephone Co., Waco.

"Good Service Your Reserve." John A. Stratton, Texas representative, Kellogg Switchboard & Supply Co., Dallas.

"Making More Money Out of the Toll Business." Sam H. Shutt, general superintendent, Texas Long Distance Telephone Co., Waco.

Protecting the Telephone

Requirements of Suitable Protection—Installation of Arresters—Types of Protective Equipment—Some "Tips" on Inspection and Maintenance of Protectors

By P. Kerr Higgons

Telephone protection is one of the most important elements of telephone engineering. While it receives considerable attention and careful study on the part of the engineer, it is strange but true that the average maintenance man neglects its proper care perhaps more than any other portion of his duties.

During the past month the writer found one place where the trouble man had been in the habit of taking the carbons out of the cable protector and throwing them on the ground, so that eighty per cent of the carbons were found on the ground, ten per cent in the terminal head and the balance missing. It is hardly necessary to state that this was the direct cause of the loss from lightning discharges of twenty-five per cent of the cable conductors in this particular cable. An examination conducted of the plant revealed the fact that the trouble man had not only removed carbons from the arresters in the cable terminals, but had also used No. 18 and 20 wire in place of fuses which had been ruptured in protecting the apparatus against external currents. In several places, the ground wire leading to the protectors at the terminals had been broken. Several others had very poor joints and in other cases the ground had been badly located and badly made up.

The importance of telephone protection cannot be too strongly emphasized and where a maintenance man persists in ignoring this important portion of the plant, he should be discharged from the service after having been warned. It was the writer's intention at this time to consider only the protective devices used in connection with substation equipment, but in view of recent experiences, he is of the opinion that the entire subject merits a thorough consideration. It is apparent that the average trouble man does not realize the function or importance of adequate telephone protection, nor does he understand the necessity of inspection from time to time and the need of repairs and replacements where faulty conditions are found.

It seems strange in the light or our advancement in telephony that there are still many telephone engineers who seem careless in the matter of providing suitable protection. In many cases there also seems to be a lack of knowledge. In some systems we find protection only in the terminal room at the central office. In others, we find protection from high tension crosses and no other kind. The whole subject, therefore, requires careful study, not only as to the apparatus to be protected, but also the dangers against which the apparatus must be protected.

What Protectors Must Do

Briefly, protection should be provided against the following hazards: lightning, where thunder storms are prevalent; sneak (or low tension) currents; strong (or high tension) currents. In many places protection is not needed at all, as for example, where lines are entirely in cable from the substation to the central office, or where lines are in a country where thunder storms are unknown and no foreign wires carrying heavy currents are near. These conditions are very rare in these days. There are three things to be protected: first, the telephone instrument and the building in which it is located; second the cable, third, the central office apparatus.

Suitable protection should meet the following requirements: first, it must possess no self induction; second, it must not be destroyed by lightning discharges; third, it must not be operated by telephone or generator currents; fourth, it must be so arranged as not to form an arc; fifth, it must be so arranged and placed as to be easily repaired and cleaned. To fulfill these conditions, a combination arrester, consisting of a heat foil or fuse wire and a carbon or open space protector, is necessary. The object of the heat coil, is to take care of any weak, or steady current, commonly known as a sneak current, which might find its way into the telephone circuit. Such a current will operate the coil by melting the solder and ground or open the line. In the types of fuse ordinarily used, the fuse wire enclosed in a rod with a vent hole to permit the gases to escape when the fuse wire melts and is so arranged as to avoid the possibility of arcing. It should be four inches long and not less than five amperes capacity.

The conventional form of open space cut out consists of two carbon blocks separated by a thin U-shaped mica separator.

Lightning Arrester Must Provide Path to Earth

In considering protection against lightning, it must be remembered that it is rare that lines are actually struck by lightning. The currents with which we have to concern ourselves may be the result of charges that are held bound on the wires by the influence of thunder clouds and flow to earth when freed by the discharge of the cloud; or may be the result of a difference of potential between different points on the earth's surface, or they may be the result of induced currents caused by the lightning discharges. The fact however remains that when these charges are set free their tendency is to go to the earth. Hence, if these discharges are permitted to pass through telephone apparatus or into cables, damage must necessarily result. A closed circuit is not necessary for damage due to this cause, as is evidenced frequently by burned out armature windings, etc. In order to protect against such dangerous static discharges, we must provide a path to ground that will shunt the apparatus out of the circuit. The only known effective protection against such static discharges is the open space cutout. In the conventional form the blocks of carbon are separated by a mica about .0055 of an inch in thickness. Such protection, properly installed, provided with a good ground and carefully maintained, will protect telephone apparatus from voltages as low as three or four hundred volts.

Current due to lightning discharge has an immense number of vibrations per second and prefers to jump over an air space rather than go through the coils of the instrument, as the coils present considerable impedance to the passage of rapidly vibrating current. The more rapid the vibrations the greater the impedance.

Lightning discharges have been known to jump over an air space of an inch or more rather than pass through a coil having only a few turns. The parts of telephone equipment most likely to be damaged are

those having windings or turns of wire such as receivers, drops, coils and armatures. Because of this tendency the line and ground wires should be connected without any spiral at the end. The spiral looks well but may prevent proper operation of the arrester. Lightning discharges will also damage paper insulated cable, especially at abrupt bends. When metallic circuits are used, the inductive disturbance or damage caused by lightning will be less than when a grounded line is used. The quantity of electricity in lightning discharges is not very great, but the amperage is decidedly high, due to the short interval of the discharge.

The history of the open-space arrester dates back to a time before the telephone was invented, as it was used for protecting telegraph lines. At that time the only protection necessary was against lightning. When the telephone

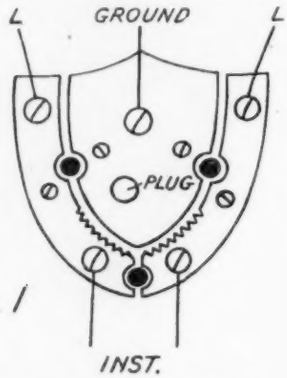


Fig. 1

SAW TOOTH TYPE ARRESTER

was invented and had come into general use, the arresters on the telephone sets closely resembled those of the telegraph type. They were made of brass plates with saw-tooth edges, separated by an air gap by a piece of paraffine paper. Fig 1a. The next step was an arrester formed by wrapping a few turns of wire around a grounded rod, this wire being insulated from the rod by means of paper or mica. It had been discovered that the best way to protect against lightning was to provide as many paths as possible for the lightning to escape to ground. It was also found that lightning discharges were not greatly affected by ohmic resistance, but were affected much more by the slightest impedance in the circuit. If we consider a coil of wire, such as is shown in Fig. 2a, a discharge would jump across the air gap separating the separate turns of the coil, rather than pass around the whole coil. The chances are that this would occur at the turns encountered first by the lightning discharge after entering the coil. It was this principle that led to the early use of the arrangement shown in Fig. 2b, which consisted of a metal cylinder around which a coil of insulated wire was wound and the cylinder grounded.

Experience over many years has shown that carbon blocks separated by mica, silk or a special paper are to be preferred for open space cutouts. When a discharge takes place, carbon is oxidized, the resulting compound, CO_2, being a gas which readily passes off, leaving the surface in better condition

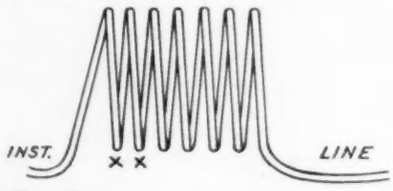


Fig. 2 a.

SHOW BREAK-DOWN JOINTS IN COIL DAMAGED BY LIGHTNIN

than before. Frequently, however, particles of carbon are liberated from the hard surface and are liable to cause a ground or short circuit if the carbons are not so arranged that the opening in the mica is turned downwards, so as to allow these particles to fall out. A discharge between metals on the other hand is liable to result in fusing the metal plates together. This is one of the disadvantages of the metal plate or block arrester, unless non-arcing metals are used. The best blocks for use where carbon blocks are not considered advisable is an alloy of zinc and antimony and these are to be preferred at the distant end of cables because the dust from the carbon blocks released during the discharge is liable to be the cause of much trouble and to increase the maintenance charges.

Heat Coil and Fuse Protectors

The thermal protector, popularly known as the heat coil, derives its name from the heating operation which is its principal feature. Such a coil placed on a line protects it in the following manner: The foreign current (greater than those used on telephone circuits) coming in over a line thus protected, encounters resistance in the coil and produces heat therein. This generated heat is concentrated at the junction of two parts of the device which are fastened together by means of a low melting solder. The coil is suspended on springs provided for the purpose. The spring tips are brought together so that when the coil is in position there is a slight tension on it. The heat produced in this coil melts the solder and releases the parts which are held by the solder. The tension of the spring opens the line on the switchboard side and grounds the line side. By providing an alarm with these coils, the buzzer will ring when the coil is blown. The core of a heat coil may be made of resistance wires or other material capable of producing enough heat to melt the solder. There are a large number of self soldering heat coils now on the market which are reliable, compact and simple and a great improvement on the coil herein described, but the principle involved is the same.

To protect against heavier currents, such as may occur in case of a cross with a trolley wire or other higher voltage circuit, the fuse is necessary. The fuse is so well known as to require little description here. Modern forms in which the fuse wire is enclosed in a fibre or clay tube are preferred to the old open mica type.

When Protection Should Be Used

It is the experience of the writer that stations should be considered exposed when the line wire is longer than one-fourth of a mile or is liable to contact with electric light or power wires. Good practice requires that an open space cutout be employed between the open wire and cable and also at the substation, when such open wire exceeds one-half mile in length, that is for protection against lightning. However, if exposed to high tension circuits, the open space cutout must be used in every case, and in this latter case, a fuse should be provided to protect the open space cutout. This is a protection against foreign currents, but not against lightning, a fact which it is very important to remember. The lo-

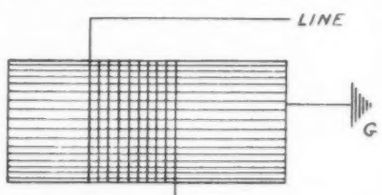


Fig. 2 b

CYLINDER TYPE PROTECTOR

cation of a choke or impedance coil between the line and the open space cutout reduces the number of cases of grounds from lightning by reflecting the lightning current. If placed back of the open space cutout, it will retard the building up of rapidly varying currents and force discharges to take place across the open space cutout. The use of copper instead of carbon blocks and sometimes of copperized carbon blocks at the cable terminal has resulted in the reduction of the amount of trouble from grounds at the arrester.

Every rural line telephone should be protected against lightning. Telephone manufacturers usually equip their telephones with an arrester consisting of round or rectangular carbon blocks separated by a thin piece of mica and mounted on the side or upper portion

of the telephone set and so connected as to protect the telephone and so arranged as to be easy of access for inspection or repairs. One type is shown in Fig. 3. These arresters are usually effective if provided with a ground wire running in a straight line to a ground rod or other conductor in contact with damp earth. All connections should be carefully soldered; otherwise they may be unreliable. When telephones are not provided with suitable or efficient arresters, an individual arrester should be placed, preferably at a point where the wires enter the building and on the outside, but protected from the elements. This latter protection is much to be preferred

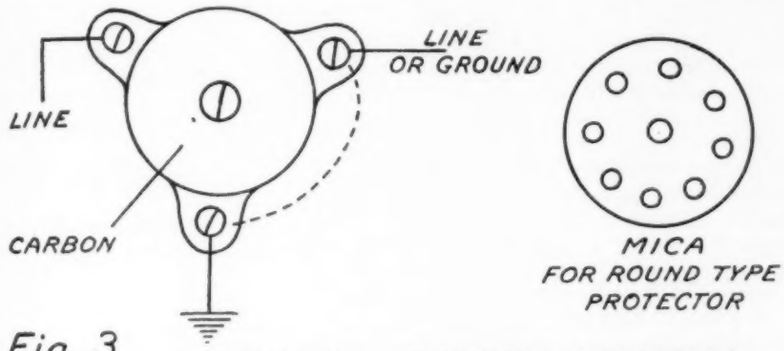


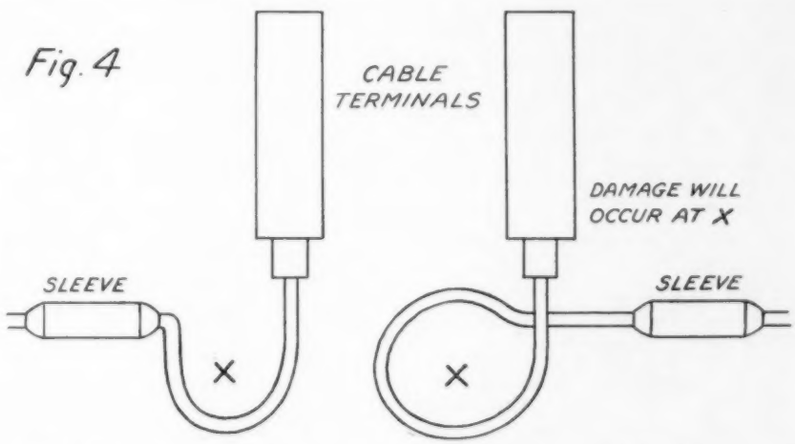
Fig. 3 ROUND TYPE TELEPHONE PROTECTOR

to that of having the protector on the telephone itself. No fuses need be provided unless the line is exposed to high tension circuits, but when used should be placed between the line and the carbon block arrester. In this way the foreign current will arc across the open space cutout and in due time burn the fuse.

Any protection is useless unless inspected from time to time. The following suggestions regarding installation and maintenance of rural line protectors might be used to good advantage. For ground wire use No. 18 B. & S. or larger. Do not install arresters in damp places or near inflammable material, such as curtains, paper, etc. Do not use more than one mica between carbons. Remember that the protector is to protect against lightning and if in doing so it should ground the line, that is only showing that it is performing its duty and was placed there for that purpose. Be careful to see that the mica is placed properly between the carbon blocks. All protectors should be mounted vertically so as to permit the carbon dust to fall out after the discharge. Lines must be connected with the fused ends of the protector. If protectors are not mounted on a slate or porcelain base, then an asbestos mat must be provided as a base. Protectors should be placed not less than seven feet from the floor and one foot from combustible material.

Mr. H. N. Faris of the Kellogg Switchboard & Supply Company makes some very good recommendations in regard to protection of rural lines. The writer has not had an opportunity to try some of them, but they sound reasonable and may be helpful to others. They are as follows:

"It is advisable to use a lightning rod on each pole where a subscriber's drop wire leads off." This wire should be of iron not smaller than No. 12. The wire is fastened to the pole with iron staples from the top of the pole to a coil of wire located at the bottom of the pole. The free top end of this wire is left protruding at the top of the pole with the point upward. This seems reasonable and the same practice might be extended to every fifth or tenth pole, thereby protecting the entire lead. The rush of the lightning discharge is usually very violent and if a suitable path along the line, such as above suggested, is not provided, the chances are



it will make an expensive one, sometimes in the most unexpected and inexplainable manner. The higher resistance of the iron wire tends to slow up the discharge and damp the oscillations, thus avoiding any sideflash. Its high melting point and cheapness are also very much in favor of its use for this purpose. Mr. Faris further recommends that "on cross arm leads, this wire should be carried across the face of the arm and that tiewire tails be left pointing toward the ground wire." Experience has proven that this effectively prevents arresters smutting on grounded lines where such trouble has heretofore been considered unavoidable. It is also possible to provide a drain for direct strokes on the outside of the house by terminating line and ground wires on porcelain knobs about three inches apart and bending the dead end tails of the two wires toward each other with a half-inch air gap between the points. The amount of lightning passing these outdoor spark gaps will never cause the slightest damage to the interior wiring or to the telephone itself, if the latter is properly wired and fitted with a disc type arrester.

Protection Against Loss of Cable Pairs

Much damage occurs where long exposed lines are connected to lead cable without suitable air space protection. The reason is that the cable itself is virtually an open space lightning protector. Having a tendency to discharge itself across a dielectric, such as air, mica or paper, the lightning will refuse to go past bends, turns or coils in the cable and will discharge itself through the paper insulation to the adjacent wires or the lead sheath, as may be most convenient. As a rule, when lightning damage of this kind takes place, it will be found in or very near the loop leading into the terminal, as shown in Fig. 4, and in many cases the lead sheath shows no indications whatever of the trouble. Damage of this kind alone, and its frequency on long, exposed lines, especially toll lines, make this subject of protection worthy of careful consideration.

Some Factors Affecting Selection of Protection

The types and forms of protective apparatus on the market today are too numerous to mention and it is difficult

for the uninitiated to discriminate between the good and bad. It is oftentimes very expensive to experiment with an untried piece of apparatus. It is better to demand evidence of satisfactory experience with such apparatus before using, and if possible, only to buy what is actually needed at the time. It will be too late to find out mistakes after cable or apparatus is damaged. Once having selected a standard protector with a good reputation for efficiency and having installed it as a part of the system, it is an imperative rule that it should be kept up to standard. When burned out or destroyed, the fuses should be replaced by those of the proper type and rating. All heat coils and carbon arresters must be kept in place and absolutely no "jumpers" or copper wire make-shifts used. No excuse, such as being "too busy" should be taken from any employe. Neglect of this kind may prove fatal, and the consequence cannot be lost sight of.

Lightning does the most damage on rural and toll lines, hence too much care cannot be taken in seeing that the apparatus is properly protected and the protector should be examined every time the lineman visits a substation, whether trouble has developed or not. The price paid for protection on farm and toll lines will prove to be a splendid investment if properly maintained.

The protection of telephone circuits has become a very important matter, not only to the subscribed, but also to the company. The subscriber looks at the question of protection from the viewpoint of security and safety. The company on the other hand adds to these features the saving of apparatus, since a small outlay in protective devices is usually more than compensated by the saving of apparatus. However, regardless of this economic viewpoint, companies must take into consideration the possible damage to human life, which financial satisfaction will not restore.

An English engineer was visiting a friend in New York, and the latter put in a call to Chicago while they were conferring. In ten minutes he was talking to the Chicago party.

The Englishman expressed his amazement at the rapidity with which a 1,000-mile connection was made, and remarked, "The English telephone system is the best in Europe, yet last month when I wanted to call London from a leading southern English city, about 30 miles from the metropolis, it took just 28 minutes to get in touch with my office at London, or nearly a mile a minute, compared with your 100 miles a minute connection."

Bell Veterans Plan Big Meeting for Atlantic City

New York, N. Y.—Telephone Pioneers of America, the organization of those who have been in A. T. and T. service for 21 years or more, are looking forward to their annual convention at Atlantic City, October 19 and 20, as the greatest affair in the group's history.

The organization has grown to such proportions that the 1923 meeting probably will be the last to be handled under the present arrangement of a general business session.

Special railroad rates have been granted for the event and attendance for all parts of the Bell system is expected to be record breaking. Headquarters for the Pioneers are at the Million Dollar Pier.

The serious business of the convention will begin with the meeting of the general assembly on the pier at 9:30 A. M. Friday. The association meeting will be called to order by Mr. Leonard H. Kinnard, president of the Pioneers, at 10:30 A. M., immediately after adjournment of the assembly, and the discussion will be on "The Telephone of Yesterday."

The "Fun, Sport, and Amusement" will start on Friday afternoon. Half of the crowd will attend a musical comedy at the Garden Pier theater at 4:30 o'clock, as guests of The Bell Telephone Company of Pennsylvania. The cast of this show includes more than seventy persons and it can be said on the best authority that the production will have a real metropolitan flavor.

Other features of the afternoon program will be a grand frolic on Steeplechase Pier, taking in the sights of the Boardwalk from rolling chairs, sailing in pleasure boats, splashing around in the famous Hygeia swimming pool, and dancing in the ball room of the Million Dollar Pier.

The second performance at the theater will begin at 8:30 o'clock Friday evening and while it is in progress there will be music and dancing and other diversions on the Million Dollar Pier for those who saw the afternoon performance. At the conclusion of the show in the theater the evening playgoers will join in the dancing.

The second session of the association will be called to order Saturday morning at 9:30 o'clock. The general theme of discussion on that occasion will be, "The Telephone of Today and Tomorrow." At this session there will be a scientific demonstration by the department of development and research of the American Telephone and Telegraph Company, the nature of which has not been announced, but which is certain to be of a most interesting character.

On Saturday afternoon the Pioneers will again have their choice of a number of diversions, including everything from a game of checkers or a trip down the "Giant Slide" to a sail on the Atlantic or a high dive into the big pool.

The banquet tendered by the American Telephone & Telegraph Company on Saturday evening will be the final feature of the Tenth Annual Meeting of the Pioneers. Three large dining rooms in three of Atlantic City's largest hotels have been reserved and the speakers will appear in person before each group.

The entertainment at the banquet will be furnished by the Western Electric Company, and will include some clever numbers which will be both surprising and amusing.

Maine Holds Lively Two-Day Session at Augusta

MAINE OFFICERS

W. J. Thompson, South China, President.

Herbert E. Foster, Winthrop, Secretary-Treasurer.

DIRECTORS

W. J. Thompson, Herbert E. Foster, Ex-Governor Carl E. Milliken, F. W. Story, H. F. Hilton, A. F. Winslow, A. Van Denkerckhoven.

Augusta, Maine.—One of the livest meetings in the history of the Telephone Association of Maine was held September 11 and 12, at Augusta. A practical program for the executives and operators was lightened by an informal dinner at which the New England Telephone and Telegraph Co. was host, and by a field day at Capital Park.

Addresses by President William J. Thompson of the association, J. G. Ihmsen of the Up-state New York organization and by Fred W. Story, assistant to the vice president of the New England Telephone and Telegraph Co. were among the features. "Public Relations" was the subject of an address by a Maine commission representative. The loud speaker was used in presenting a long distance address on "System" from the executive headquarters of the New England Bell unit. F. E. Waring's paper on "Accounting," and the operators' helps advanced by Miss Lillian Vavasour, also were high-lights of the practical program. The headliner on the closing day was George F. Haberman, telephone engineer for the New England Bell, who presented a paper on "Standardization." Resolutions favoring the repeal of the federal telephone tax were passed.

Gainesboro, Ky.—Property of the Allen County (Ky.) Telephone Co. has been purchased by the Gainesboro Telephone Co. The reported price is $35,000.

Designing the Loud Speaker

Some of the Features to Be Considered in Improving Loud Speakers—An Opportunity for Telephone Makers—Reducing Current Cost—Lessons from Phonograph Design

By John B. Rathbun

Probably one of the most fertile fields in light electrical manufacturing is that of loud speaker production, that is, the production of a loud speaker which is free from the distortion and "rawking" of the present day horn type. Little real improvement has been made since the introduction of the Magnavox principle, which as we know, is far from perfection. Whether or not the conventional form of magnetically actuated diaphragm will be the ultimate type, is a question, but it is certain that the design of the sound chamber must be altered radically. With the facilities possessed by the telephone manufacturer for carrying out such research work it would seem that at least a partial solution could be had within a comparatively short time.

Present loud speakers consume an amount of energy that is all out of proportion to the results obtained in terms of sound volume. Very few will work even strong local stations properly on one stage of amplification with a regenerative set and most of them work only moderately well on two stages. This means an expenditure of at least 0.75 watt and with some tubes as much as 2.4 watts for only a moderate volume of sound. Too much attention has been paid to the development of the receiving apparatus and amplifiers and not enough to the sound creating portions which are represented by the headset and loud speaker. Radio circuits change radically day by day, but the heart of the system remains practically unchanged except for a few minor details.

Current consumption in a radio set is of far greater importance than would be ordinarily believed. In the first place, frequent recharging of storage batteries or the replacement of dry cells is a most decided nuisance and furthermore is expensive. With a three-tube set consuming 2.4 watts per hour and an electrodynamic speaker taking 4.8 watts per hour, we have a total of 7.2 watts per hour which will cost from 10 to 20 cents per hour, depending upon the method of renewing the energy. Add to this the cost and depreciation of the amplifying apparatus, and we have a right good round sum for listening in via the loud speaker.

Secondly, it should be noted that the cost of the loud speaker is not that of the speaker alone but also involves the purchase of amplifying equipment and other expenses which result directly from the great amount of energy that must be handled. Even with the lowest priced outfits with a speaker at $15.00, amplifying unit at $25.00 and tubes at $13.00, we have a total of $53.00 list price, which is prohibitive to the greater majority of radio enthusiasts. This, of course, is "Gyped" down to about $35.00 in some of the cut rate stores, but even this is far too high. As soon as we dispose of the problems of excessive energy, just so soon will we make the loud speaker a practicable commodity.

A few experiments performed by the writer show that it is possible to obtain good speaker volume with as low as 0.5 watt hour, but with the crude apparatus employed the quality was inferior, that is, the tone was very poor and there was a decided tendency toward "knocking" on strong local reception. These are defects which can no doubt be removed with proper attention to the design of details.

Tone Quality

Next we come to the question of tone quality which is not so easily disposed of. This seems about equally divided between the diaphragm, the actuating methods and the sound chamber. That we cannot hope to obtain a pure tone from the conventional horn seems to be certain, hence we must seek other designs of volume boxes which will not introduce characteristic overtones or reverbrations in the system. In my opinion horn design has about reached its limits and we must look into other forms of chambers which at once have greater tone purity and which are more sightly and compact in form. Such chamber should follow the general outline of the receiver cabinet of which it is to form a unit, thus avoiding the ungainly and awkward conical fish horn of the present day. Such units have already been placed on the market, which either conform to the outline of the receiver cabinet or are incorporated into the cabinet with the apparatus, but they are sadly deficient from other standpoints.

Strange to say, the majority of loud speaker manufacturers do not take a leaf from the experience of the phonograph builders in the construction of the sound chambers. Thousands of dollars have been expended in experimental work by the phonograph makers in the development of materials and sound box design which is at the command of the maker of loud speakers and yet these examples have not been followed. The exclusive use of wood or other non-resonous materials in phonographs indicates that this sort of material will be the ultimate in speaker chambers, but so far only a few makers have adopted it. That tin horns give tinny music cannot be denied. Sheet metal has no place in the construction of any part which comes into contact with the vibrating air column.

Such parts should be absolutely "non-selective," that is, there should be no part which will vibrate in response to any particular wave frequency. Should this occur, then there will be resonant amplification of certain tones which will lead to distortion and disagreeable noises. Long thin unsupported surfaces have definite natural periods which pick up and amplify certain tones in the reproduction. A number of such surfaces, all having a different natural period, result in the unnatural tones of the present day speaker. Tortuous chambers and improperly balanced volumes in the various parts of the instrument create reflections and echoes which still further add to the trouble. The problem is a complicated one and can only be solved by actual experiment with many different forms of boxes.

Diaphragm Design

Various forms of diaphragms have been experimented with and various materials have been employed. Sheet metals such as iron and aluminum have been used with indifferent success. Mica, bakelite and even spruce have been used with improved results, but still fall short of being the ideal materials. The great rigidity and lightness of an exceedingly thin strip of mica causes it to be one of the most satisfactory materials to date, but the fact that it is non-magnetic necessitates the introduction of certain linkages and connections which adds to the inertia of the diaphragm and introduces

corresponding distortions. Bakelite has certain advantages which are offset by the additional energy required to bend the comparatively thick layers. Thin spruce wood diaphragms have a wonderful natural tone, but can only be used in large pieces and with special actuating devices.

Volume and intensity of sound varies with a number of factors. First, they depend upon the volume of air acted upon by the diaphragm. Secondly, upon the degree of diaphragm deflection, and thirdly upon the strength of the permanent field magnet. An increase in any one of the three items correspondingly increases the volume or loudness. The Baldwin unit, which is probably familiar to all of our readers, employs either a mica diaphragm or bakelite diaphragm which is given a comparatively great deflection by means of an oscillating pivoted armature which is connected to the diaphragm through a linkage train. This is quite satisfactory when it is not forced, but when operating under full amplification it has a tendency toward chattering and knocking. The inertia of the parts is considerable, and while very sensitive, the inertia puts in its claim of recognition when the Baldwin unit is being forced.

In the "electro-dynamic" system a light moving coil of wire is attached to the center of the diaphragm, and is placed at the poles of a powerful electro-magnet. The fluctuating sound frequency currents passing through the diaphragm coil cause it to move up and down in phase with the currents and a considerable diaphragm deflection is had. This construction makes it possible to employ any desired diaphragm material, either magnetic or non-magnetic. Again we have to deal with a considerable weight and inertia, but mechanical complications are avoided. One of the principal disadvantages of this system is the amount of current drawn for the excitation of the electro-magnet, this current being drawn directly from the batteries, as with the filament current.

Quite wonderful results in regard to tone purity have been attained at least experimentally by employing a comparatively large diaphragm of spruce. This is about one thirty-second of an inch thick and measures approximately ten inches square. A small iron armature is placed at one end of the spruce panel which is acted upon directly by phone magnets in the usual way. The other end is rigidly supported. The great surface of this diaphragm enables it to work upon a very large volume of air without the introduction of special tone chambers, and as both sides of the diaphragm are active, great volume is attained very simply and without an excessive amount of energy. This probably is one of the purest toned loud speakers now in use. The Pathé speaker also uses an external diaphragm which acts directly upon the outside air without air chambers. This diaphragm is a cone of parchment, about ten inches in diameter, which is connected by a light wire to the actuating magnet placed near the center of the cone.

These are only a few of the methods which are being tried out in an endeavor to cure loud speaker ills, and should suggest other and still better methods to those conversant with the art. If the large diaphragm of the Pathé and spruce panel speaker can be properly protected, they at once insure great volume and clarity of tone without entering into the sound chamber design problems, but like the horn, they are bulky and awkward to handle. For the ideal speaker, the dimensions should not greatly exceed 6″x8″x8″, and should be contained in a simple rectangular box.

Big Telephone Expansion Planned by France

In the use of telephones, France comes ninth with one station for every 82 persons, which is ten times less than the United States and less than Luxemburg, Cuba and Finland. In the matter of telephone traffic and modernity of plant France is 20 years behind the United States, Sweden, Denmark and Canada. The French government has, however, been moved to take action and proposals presented to and sanctioned by parliament comprise a programme of big reforms to be completed in ten years, and to cost over two milliards of francs; and a thorough-going financial and administrative recasting of the post, telegraph and telephone services. In detail some of the works contemplated are: new telephone offices, 125,000,000 fr.; new postal or mixed offices, 177,000,000 fr.; furniture and apparatus, 30,000,000 fr.; rolling stock, 22,000,000 fr.; telegraphic material, 68,000,000 fr.; and telephone material, 1,719,000,000 fr. Seven new telephone trunk lines are to be erected, including one from Paris to London, while automatic exchanges are to be widely installed, says Electrical Review, London.

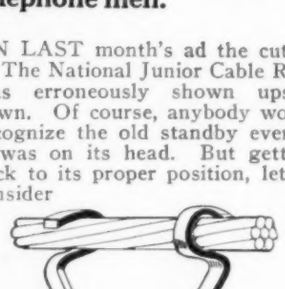
M. T. Sherman Buys Cassville (Mo.) Telephone Plant

Springfield, Mo.—M. T. Sherman, formerly division plant superintendent of the Southwestern Bell Telephone Co. here, has bought the Cassville, Mo., telephone company from Mrs. Callie Wells.

Even The Best of Us Become Upset At Times

BUT "NATIONAL" Junior Cable Rings know that position is everything in this world because they are esteemed so highly by telephone men.

IN LAST month's ad the cut of The National Junior Cable Ring was erroneously shown upside down. Of course, anybody would recognize the old standby even if it was on its head. But getting back to its proper position, let us consider



National Junior Cable Rings

"The ring with the tension grip" looks so simple one might wonder if it is at all different from others. That very simplicity of design, with its marvelous tensile gripping power, and wide space for reclipping makes this ring a prime favorite on thousand of miles of line.

National C-B Knobs

For drop wires, you should have an insulator that adjusts itself to all directions of pull. The flexibility and durability of this knob is your assurance of successful installation.

THE NATIONAL TELEPHONE SUPPLY CO.
5100 Superior Ave., Cleveland, O.

Valuation in Rate Making

Chapter XVIII—Non-Physical Assets (Continued)

By Charles W. McKay, Associate Editor*

In the August issue, an illustration was presented showing the correlation between Cost of Establishing Business (or Going Value as it is frequently termed) and the value of the purely physical property. This illustration was taken from the testimony presented by Mr. Kempster B. Miller in a now famous telephone rate case. It is suggested that the reader review this illustration before considering the subject matter presented in this installment.

The total Cost of Establishing Business may be divided into three components:

(1) Cost of Organization and Development.

(2) Cost of Selling Service.

(3) Net Interest and Operating Deficit during the Business Development Period.

Organization

It is quite evident that an organization, from executives down to operators and laborers, could not be gathered together (in the assumed reproduction of a telephone property) without an expenditure of money. Among other expense items to be considered are those involved in the training and schooling of operators before they become proficient enough to do useful work. Another factor to be considered is the cost of assembling and training the necessary maintenance forces and the cost of gathering together the necessary executive organization.

There is still another factor to be considered (if we adhere strictly to the reproduction cost theory)—at the time the new plant begins to function it will be necessary to give free service to a number of subscribers. The reason for this will be obvious. Patrons will not pay for service until the company has enough subscribers to warrant a service charge for telephone communication.

Under the plan we are now considering, for evolving a figure representative of the total Cost of Establishing Business (or Going Value)—it is customary, arbitrarily, to take two and one-half per cent of the total cost of the physical property (including the collateral construction costs) as representative of the "Cost of Organization and Development."

Cost of Securing Customers

It has been generally recognized by courts and commissions that a certain cost is involved in securing new subscribers. This cost resides in the salaries and expenses of solicitors; the amounts expended for advertising and in the actual clerical expenditures which may be allocated to the enrollment of new subscribers.

In the evaluation of a telephone property, for rate purposes, it is customary to review past records and determine an average cost per station for several years, antedating the time of appraisement. This cost applied to the total number of stations in service at the date of appraisement will give a fair approximation of the cost of selling service—as considered in connection with the reproduction cost theory of appraisement. Cost of selling service may range from four to eight dollars per station — dependent upon the exigencies of the case under consideration.

Net Interest and Operating Deficit During Business Development Period

To compute, properly, the Net Interest and Operating Deficit during the Business Development Period it is necessary to assume a construction schedule. In so doing the items of Collateral Cost; Cost of Organization and Development, and the Cost of Selling Service should be prorated over the construction period.

Fig. 39 illustrates a typical construction schedule as used in connection with the computation of the net interest and operating deficit for a moderate sized telephone company. It will be noted that the assumption is made that the actual construction of the physical property will be consummated in a period of twenty-one months—or, in other words, that the plant will be sufficiently completed at the end of the third quarter of the second year to warrant a vigorous prosecution of the work incident to building up the organization and securing new subscribers. As a matter of fact, the actual activities of the administrative organization, and of the sales forces, will begin about six months prior—or at the end of the first one and one quarter years.

Referring again to Fig. 39, the first item is the Direct Construction Costs; while the second, third, and fourth items refer to the Collateral Costs. The fifth item represents the Total for Computing Interest, and the sixth item shows the Accrued Interest (per quarter) during the actual construction period. The seventh item represents the total cost of the Physical Property —the grand total, in this case, being $234,477.00.

The allocation of the Cost of Organization and Development and Cost of Securing Subscribers is shown in the table presented in Fig. 40. The first item in this table, it will be noted, is identical with the last item as presented in connection with Fig. 39. In other words, it represents the Total Reproduction Cost of the Physical Property —properly allocated over the various

INTEREST DURING CONSTRUCTION

Item	FIRST YEAR 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	SECOND YEAR 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	THIRD YEAR 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total
1. Total Direct Construction Costs	3,800	10,948	22,826	24,842	41,191	34,787	23,031	6,776	6,776	5,432	4,278	9,430	200,117
2. General and Legal Expenses	2,260	2,260	1,695	1,695	1,695	1,130	565	.....	.....	....	....	....	11,300
3. Eng. and Gen. Supervision	2,001	2,001	1,501	1,501	1,501	1,001	500	.....	.....	....	....	....	10,006
4. Insurance and Taxes	....	143	235	279	460	478	516	.....	.....	....	....	....	2,111
5. Total for Computing Interest	8,061	15,352	26,257	28,317	44.847	37,396	30,612	.....	.....	....	....	....	190,842
6. Interest during Construction	120	231	731	800	1,970	1,660	5,431	.....	.....	....	....	....	10,943
7. Total Cost Physical Property	8,181	15,583	26,988	29,117	46,817	39,056	36,043	6,776	6,776	5,432	4,278	9,430	234,477

Note: Operation starts at the beginning of fourth quarter of second year.

Fig. 39

*Mr. McKay is Manager of the Valuation Division of The Roberts-Pettijohn-Wood Corporation, Consulting Engineers, 646 North Michigan Avenue, Chicago.

quarterly periods. The second item shows the allocation of Cost of Organization and Development; the third item, the allocation of Cost of Securing Subscribers. Item No. 4 represents the assumed Operating Deficit; while Item No. 5 represents the Base for Computing Interest. Item No. 6 shows interest at 6% (compounded semi-annually); and the Total Interest is found to be $26,631.00. It must be remembered, however, that Interest during Construction (for the purely physical property) has already been computed in connection with Collateral Costs—the total being $10,943.00—(see total for item No. 6, Fig. 39). Also, the difference between the assumed Earnings and the Deficit—during the Business Development Period—amounts to $8,333.00. These two items—Interest during Construction Period ($10,943.00) and the total of the Net Earnings during the business building period ($8,333.00)—must be deducted from the total of $26,631.00. This leaves $7,355.00—as representing the Net Interest and Operating Deficit during the business building period.

We have already assumed that the total cost of organizing and developing the business will be $5,862.00 and the total cost of securing subscribers $8,789.00. Hence we may summarize the total Cost of Establishing the Business as follows:

1. Cost of Organization and Development ..... $ 5,862.00
2. Cost of Securing Subscribers 8,789.00
3. Net Interest and Operating Deficit 7,355.00

Total Cost of Establishing Business $22,006.00

In the November installment of this series of articles the subject of Cost of Establishing Business will be discussed more in detail and brief consideration given other items component to the total of the "Non-Physical Assets."

CALCULATION OF NET INTEREST AND OPERATING DEFICIT

Item	FIRST YEAR 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	SECOND YEAR 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	THIRD YEAR 1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	Total
1. Total Reproduction Cost Physical Property.....	8,181	15,583	26,988	29,117	46,817	39,056	36,043	6,776	6,776	5,432	4,278	9,430	234,477
2. Organizing and Developing	....	.....	.....	.....	.....	1,160	1,160	1,020	845	735	565	377	5,862
3. Cost Securing Customers	....	.....	.....	.....	.....	879	1,320	1,757	1,757	1,320	878	878	8,789
4. Operating Deficit	....	.....	.....	.....	.....	.....	.....	1,562	626	*1,320	*3,201	*6,000	*8,333
5. Base for Computing Interest	8,181	15,583	26,988	29,117	46,817	41,095	38,523	11,115	10,004	6,167	2,520	4,685	240,795
6. Interest at 6% compounded semi-annually.	61	240	563	984	1,577	2,236	2,890	3,263	3,514	3,635	3,807	3,861	26,631

Note: Items marked (*) denote earnings.

Fig. 40

Wm. M. Bailey, Richmond (Ind.) Manager, Dies Suddenly

Richmond, Ind.—Wm. M. Bailey, general manager of the Richmond Home Telephone Co. for 22 years, died suddenly here of heart failure on September 2. Mr. Bailey was 55 years old. He entered the telephone business with the Southern Bell Telephone and Telegraph Co. when he was 18. In 1897 he entered the Independent field in the south and became general manager of the Richmond company in 1901. His able management built the company from 1,000 to 5,200 subscribers, and earned for the Richmond property the reputation of being one of the best handled in the state. When he went to Richmond the Bell was competing with the Home interests but eventually retired.

Mr. Bailey was active in association affairs.

Pocket Rate Book Increases Redlands (Cal.) Tolls

Redlands, Cal.—The Southwestern Home Telephone Co., of Redlands, has issued a vest pocket rate book giving long distance rates between Redlands and principal points in California and the rest of the United States. Space also is devoted to a personal telephone list and to some promotion literature on long distance service. The Southwestern Home, headed by that able telephone executive, Charles A. Rolfe, is an active advertiser in making the most of its development opportunities.

Albert M. Howell, Head of Hillsboro (Ill.) Company, Dies

Hillsboro, Ill.—Albert M. Howell, president and general manager of the Montgomery County Telephone and Telegraph Co., died here September 11, after an illness of three years. Mr. Howell was originally in the lumber business, and retired from that field after 43 years work in it to concentrate upon his large holdings in the Montgomery County company, of which he was one of the four organizers in 1895. As a result of Mr. Howell's efforts the company became one of the most prosperous utilities in that section of the country. He was prominent in other local industries and in Hillsboro civic life.

Wisconsin Telephone Pay-Roll $2,000,000

Madison, Wis.—More than $2,000,000 a year is paid out in salaries to employes of telephone companies in this state exclusive of the exchanges of the Wisconsin Telephone Co., according to a survey just completed by John A. Pratt, secretary of the Wisconsin State Telephone Association.

His survey shows that the pay-roll for operators of the independent group of telephone companies for 1922 was $785,309; general office salaries, $271,714, maintenance and construction department, $784,976, giving a total pay-roll of $1,841,999, for 2,320 employes of 282 companies.

Kenton Telephone Controversy Referred to Ohio Utilities Commission

Kenton, O.—Acting through Hardin County Pomona Grange, a group of subscribers of the Kenton Telephone Co. have filed a resolution with the Public Utilities Commission asking an investigation of a controversy between the company and some of its rural subscribers. The resolution sets forth that a sleet and rain storm on Dec. 27, 1922, put out of service many of the telephones of the company and that many members of the grange were out of service for thirty to sixty days. It is claimed that the company has been arbitrary in refusing to accept payment for less than the full period and in refusing to allow the discount for prompt settlement to those subscribers who declined to pay the full rental for the period of alleged faulty service.

French Politics Delay International Telephone Plans

Paris, France.—It is reported that negotiations being conducted by Sosthenes Behn, president of the International Telephone and Telegraph, for the purpose of welding the continental European telephone system, are temporarily at a standstill due to the French political situation. It is expected that an agreement with the French government will be effected at an early date, and be followed by similar contracts with other European countries.

Independent 4½% Views

Leaders in the Independent telephone field are giving thought to TELEPHONE ENGINEER'S suggestion of an Independent fund somewhat similar in its function to the Bell's four and one-half per cent proposition.

Expressions from F. B. MacKinnon, president of the United States Independent Telephone Association, and from W. F. Goodrich of La Crosse, Wis., bring out some interesting points that are well worthy of consideration in view of the attention that probably will be devoted to this matter when the big Independent meeting is held in Chicago this month.

Mr. MacKinnon says:

"Naturally, in my position, I have had occasion to give some thought to such a proposition. Owing to the number of Independent companies and the extent of territory covered by them, and to the fact that the manufacturing companies, through their engineers and traveling representatives, render a great deal of technical service to our operating companies, and also owing to the fact that our larger companies advise the smaller ones without charge as to plant, traffic and commercial matters, I have never been able to see how we could develop an organization similar to that of the American Telephone & Telegraph Company's general staff, except by a process by which Independent properties could be standardized and a closer relationship established between our many companies.

"We have endeavored for a number of years to render such service as is needed in connection with Federal government matters and have come to be a general staff for such purposes. We have been urging our companies to affiliate as fully as possible with the State Associations, so that they might have a working organization for handling state government problems; but neither the national organizations, nor the state organizations have been able to build up a staff for properly handling technical matters, nor have the organizations been able to provide the financial assistance which is given its subsidiary companies by the American Telephone & Telegraph Company.

"My own belief is that in pursuance of our general plan, we should immediately arrange a program which will bring into closer touch our larger companies, and through that close touch form a general staff that will be able to advise the smaller companies on engineering, traffic and commercial problems. We should also take an advance step in the matter of securing a closer affiliation in the membership of the National Organizations between the large and the small companies so as to unite that membership into a compact working organization.

"In considering the application of the Bell general staff plan to the Independent group, it should be remembered that in addition to the general staff, the Bell System has twelve large subsidiary organizations, each of which has a general staff and that under those subsidiary general staffs, are division and district staffs. To render an adequate service to our people it would be necessary to build up a similar organization. This to my mind can eventually be done, but it has, as I have said, to be done by a gradual process and will come only when all of the Independent companies have been welded into a compact organization.

"After all, as in most propositions, it resolves itself into the question of where the money is coming from. Experience with association work has shown us that we must have a more active co-operation from our member companies before we can expect to be allowed to render the service which those companies need and cannot appreciate until it is rendered them and which they are unwilling to pay for until they appreciate its value.

"Your editorial suggestion, I hope, will arouse sufficient interest for such a discussion of the problem as will eventually lead to real results."

Mr. Goodrich also brings out the fact that the bigger companies are carrying the burden pretty generally under the present conditions.

He states:

"Of the two Independent organizations, the U. S. I. T. A. and the State Associations, both are voluntary and have to be financed. In general the more faithful and larger organizations are doing the financing for the benefit of the many who are receiving such services, as it is possible for them to give under the present condition, and this has been mostly in an educational way and such services as are needed in connection with government matters. That service has been of much benefit and while the financial burdens should be more evenly distributed, these voluntary organizations have not the power to force any payment for the service rendered.

"Both organizations are endeavoring to extend their service and they must get into closer touch with the operating companies and provide them with a technical department that will be better able to advise and serve especially the smaller companies on engineering, traffic and commercial problems. We must not forget to give proper credit for the valuable technical service rendered by the independent manufacturers which has always been indispensable. I hope the campaign by TELEPHONE ENGINEER will help to increase the co-operation and contributions to these two organizations so that finances from this source may be adequate in lieu of a similar 4½% payment of the Bell units."

More Bell Office Buildings Than All New York

New York, N. Y.—If all buildings owned by the A. T. and T. Co. were grouped together they would make a business community with 400 more buildings than the total number of office buildings in New York City.

WANTED

High grade young men to travel extensively as Radio Salesmen for well known manufacturer of established mechanical and electrical lines. Must be capable of highest type of sales and service work in demonstrating and introducing line of patented radio equipment. Men preferred who have good electrical education in addition to fine practical knowledge of up-to-date radio apparatus. Character references required. Excellent opportunity for promotion as Sales and Service Engineers. Write stating experience, education, age and salary desired.

Address reply to
G.W.S., care of Telephone Engineer
56 West 45th St. New York City

FOR SALE
Telephone Exchange in Wisconsin
267 SUBSCRIBERS
137 individual and 130 party lines
Equipment: Kellogg, Stromberg-Carlson and Leich. Business District lines under ground. Bell Long Distance connections. Good rates. Located in prosperous agricultural district.
Write: ALFRED MacARTHUR
29 South La Salle Street, Chicago

Charles W. McKay
Consulting Telephone Engineer
Valuations — Rate Cases — Plant Problems
Manager, Valuation Division
The Roberts-Pettijohn-Wood Corporation
646 North Michigan Ave., Chicago, Ill.

J. G. WRAY & CO.
Telephone Engineers
Specialists in Appraisals, Rate Surveys, Financial Investigations, Organization and Operation of Telephone Companies.
J. G. Wray, Fellow A. I. E. E.
Cyrus G. Hill
1217 First National Bank Bldg., Chicago

Antennae Tuning Calculation

How to Work Out Proper Design of Antennae by Simple Mathematics — Getting Proper Facilities for Reception—A Job Full of Avoidable Pitfalls

By R. T. Cloud

There is nothing new in this wireless telephone stuff to the telephone man that has had any experience with grounded farm lines. He well knows the proclivity of electric currents to travel through space unaided by wire connection.

These lines, in fact, sometimes resemble the now familiar outdoor antennae. In the discussion to follow we will treat of antennae from a receiving standpoint only.

The antenna is the collector of energy from the passing radio waves and while good receiving is often done on a comparatively poor antenna by means of multi-stage amplifiers, the most efficient and economical results are accomplished by means of a good antenna.

Radio waves traveling through space have two components, one an electrostatic and the other an electromagnetic. Antennae may be designed to intercept either of these components and transfer their energy to a suitable device for converting into audible signals.

The antenna consisting of one or more wires strung above the ground operates to intercept the electrostatic component of the wave while the antenna consisting of a comparatively large loop of wires intercepts the electromagnetic component of the waves.

One or more wires strung above the earth forming the well known antenna has two electrical properties, that of capacity in which the wires form one plate of a condenser and the earth the other, and that of inductance due to the electric field set up around the wire by any electric current traversing the wire.

Naturally having these two properties the electrical system has a natural period of oscillation at a frequency of

$$F = \frac{1}{\sqrt{La\ Co}}$$

In this case La is the low frequency inductance of the antenna, which is somewhat different from the usual values as calculated for a wire stretched above the earth. As the wire is open at one end and the high frequency currents are not of uniform values throughout the circuit the value of La is ⅓ the uniform value of inductance as usually calculated.

Expressing the frequency in terms of meters wave length and changing the values of the inductance and capacity terms to more convenient units the formula becomes

$$\lambda = 1884\sqrt{La\ Co}$$

Where λ = wave length in meters.
Co = capacity in microfarads.
La = inductance microhenry.

This value is called the natural wave length of the antenna. Very roughly the natural wave length of an antenna is about four times its physical length including lead in, in meters.

Thus, a 120-foot aerial and lead in, which is about 36 meters, would have an approximate wave length of 4 times 36 or an approximate natural length of 144 meters.

It is usually necessary to modify the natural wave length of an antenna by inserting additional inductance and sometimes additional capacity for tuning purposes; in such cases one or both these supplementary devices are made variable.

Where an inductance is added to the antenna to increase the wave length response, also to serve as a means of transferring the energy to the receiving set, the value of this inductance should be added to the antenna inductance in making the wave length calculation. Our formula thus becomes

$$\lambda = 1884\sqrt{(La + L)\ Co}$$

in which L is the added inductance.

As in most cases La is very low compared with L, and L is made variable by means of taps or otherwise it is sufficient for rough calculations to take the value of L only and neglect La in the formula. In order to facilitate calculations of this nature a table of antenna capacities is given in Table 1 for single wire L aerials which are most suitable for receiving.

Thus assuming that we have an antenna of the following dimensions: Length 80 feet, height 40 feet, what value of inductance is necessary to tune to 400 meters?

From the table the capacity of the antenna would be .000179 microfarads, neglecting antenna inductance and substituting the above value of capacity and wave length in formula

$$\lambda = 1884\sqrt{L\,C}$$

and solving for L

$$400 = 1884\sqrt{.000179L}$$

$$.000179L = \left(\frac{400}{1884}\right)^2 = .0449$$

L=250 microhenry or 0.25 milhenry.

This value of inductance lies between a 50-turn and a 75-turn honeycomb coil, and if these are to be used, use a 50-turn coil and add to the antenna capacity by shunting the coil with a variable condenser to tune to the desired wave.

In such cases the wave length range with any given value of inductance can be determined by adding the capacity of the antenna to the minimum and maximum values of the variable condenser and solving for wave length. For example take the antenna given and determine the wave length range with a 23-plate condenser in shunt around the coil.

Of course, variable condensers vary as to maximum and minimum values, but a good average value for a 23-plate condenser connected in the circuit would be .000018 microfarad minimum and .000515 microfrad maximum. Add to these values the capacity of the aerial .000179 microfarad and we obtain a minimum capacity of .000197 microfarad and a maximum of .000694. A 50-turn honeycomb coil will have an inductance of about 149 microhenry. Substituting these values in the formula

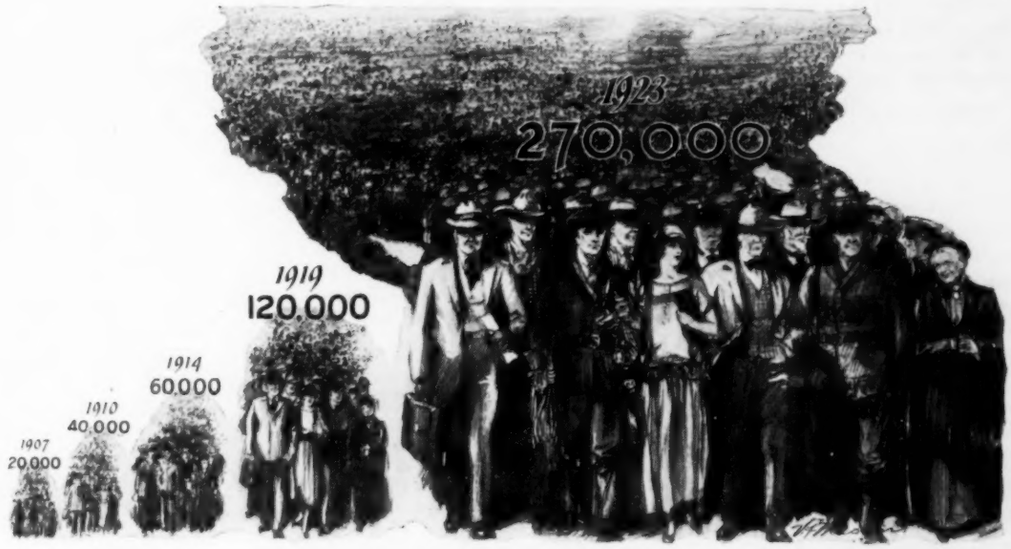
$$\lambda = 1884\sqrt{L\,C}$$

we have a minimum wave length of

$$1884\sqrt{149 \times .000197} = 323 \text{ meters}$$

Table I

Height in Feet	Capacity Single Wire Antenna Horizontal Length 40	60	80	100
30	.000105	.000143	.000185	.000227
40	.000099	.000140	.000179	.000220
60	.000097	.000137	.000177	.000216
80	.000096	.000134	.000169	.000213
100	.000095	.000133	.000168	.000212



These groups of stockholders illustrate the rapid growth in ownership of the Bell System.

A Community of Owners Nation-wide

"Who owns the company?" "What is behind it?" These questions are asked in appraising the soundness of a business and in determining its aims.

The American Telephone and Telegraph Company is owned by more than 270,000 people living in every state in the Union. Could the stockholders of the Bell System be gathered to one place, they would equal the population of a city about the size of Providence or Denver.

They constitute a representative cross-section of American citizenship. Among them, of course, are bankers and men of large affairs; for the idea of ownership in the Bell System appeals to sound business judgment and a trained sense of values.

In this community of owners are the average man and woman, the storekeeper, the clerk, the salesman, the professional man, the farmer and the housewife—users of the telephone who with their savings have purchased a share in its ownership. The average individual holding is but twenty-six shares.

No institution is more popularly owned than the Bell System, none has its shares distributed more widely. In the truest sense it is owned by those it serves.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service, and all directed toward Better Service

and a maximum wave length of

$$1884\sqrt{149\times.000694}=605 \text{ meters}$$

Some circuits require a condenser in series with the antenna and inductance. In such cases treat the antenna capacity and the inserted capacity as two condensers in series and reduce to an equivalent capacity by the formula

$$C=\frac{1}{\frac{1}{Ca}+\frac{1}{Cc}}$$

In which

C=Equivalent capacity of antenna and condenser.

Ca=Capacity of antenna.

Cc=Capacity of condenser.

Use this equivalent capacity in calculating wave length of antenna.

Naturally as an antenna is seldom erected under ideal conditions all theoretical calculations can only approximate actual conditions, therefore in building circuits allow sufficient margin to meet these conditions.

Resistance Constant

Receiving antennae have another constant in addition to inductance and capacity, that of resistance.

The current set up in a receiving antenna is dissipated in three ways, (1) that transferred to the receiving set; (2) heat due to the conductor resistance; (3) heat, due to dielectric absorption. The first of these is the only useful dissipation of energy and in order that this may be maximum the second and third must be reduced as much as practicable.

The second item or ohmic resistance may be reduced by using a comparatively large wire, or better still a stranded Litz wire; also should have a good ground connection.

The third item, dielectric absorption, is due to the aerial being an imperfect condenser, due to trees, buildings, etc., being in the dielectric field of the antenna. At short wave lengths this absorption is many times that due to ohmic resistance and explains why poor reception is often met with on antennae that is apparently properly erected and insulated.

In erecting an aerial locate as far as possible over open spaces and with as few trees, buildings and structures as possible under the aerial.

The wave length of loop aerials is governed by the inductance of the loop, the distributed capacity being very low it is therefore necessary to shunt the loop with a variable condenser for tuning purposes.

In general, loops are not as efficient as antenna and in order to obtain long distance reception require one or more stages of radio frequency amplification. However, as they have good directional properties they eliminate a great deal of interference and static, and are a great convenience where it is difficult to erect an outside antenna.

The amount of energy intercepted depends on the size of the loop and in the spacing of the wires. The best spacing is as follows:

Size of loop (feet)	Spacing between wires (inches)
2 x 2	1/10
4 x 4	1/4
6 x 6	7/16
8 x 8	9/16

The best wave length and wave length range of loop shunted with a 23-plate condenser is as follows:

4′ x 4′		
Turns	Best wave length	Wave length range
3	250	200- 350
4	300	250- 400
6	350	300- 800
10	600	350-1,000
20	1,200	900-1,800
6′ x 6′		
Turns	Best wave length	Wave length range
3	220	180- 400
6	500	400- 900
10	700	600-1,200
20	1,400	1,000-2,000

The loop aerial takes many forms. The above tables are for a square frame with the wires wound side by side solenoid form.

In the practical form loops should be wound with as large wire as practicable; this not only gives a low high frequency resistance, but the wires are not so likely to vibrate and interfere with tuning.

How The Large Cities Rank as to Telephones.

Detroit, the fourth city in the United States in point of population, stands seventh in number of telephones within its boundaries.

Standing ahead of Detroit in number of telephones are New York, Chicago, Boston, Philadelphia, Los Angeles and San Francisco, in the order named, although only New York, Chicago, and Philadelphia lead in population.

That does not mean that Detroit residents use the telephone any less than do the people of other large cities. In all of them the use of telephone service is increasing rapidly. The telephone development in New York, Philadelphia and Chicago is so much heavier than in Detroit because their populations greatly surpass that of Detroit.

The Boston telephone area, on the other hand, includes practically all of Boston's suburbs, or a total population, including that of the city, of 1,600,000, compared with Detroit's estimated 1,250,000. Boston, too, is a city of long established residents and is without the great industrial population characteristic of the center of automobile manufacture.

Western cities, particularly those visited annually by hundreds of thousands of tourists, naturally have a large telephone development because of that transient population, which does not, by the way, figure in the census reports.

WANTED: Copies of TELEPHONE ENGINEER for June, 1923. Your subscription will be extended two months for each June copy sent us. Address: TELEPHONE ENGINEER, 28 E. Jackson Blvd., Chicago.

The Claar Telephone Co., of Bedford, Pa., Jesse H. Claar, manager, has purchased the lines and equipment of the Bedford County Telphone Co.

WIRE TABLES (HH-10-20)

PROPERTIES OF ELECTRICAL WIRE

GALVANIZED IRON AND STEEL WIRE. The following table applies to Double Galvanized Telegraph and Telephone wire of the highest grades and is taken from a table by Roebling. The Gauge numbers are Roebling numbers with a parallel column showing the diameters in inches.

DOUBLE GALVANIZED TELEGRAPH AND TELEPHONE WIRE

Roebling Gauge No.	Diam in Inches	Weight Lbs. per Mile	Approximate Breaking Strength in Pounds			Resistance in Ohms at 68°F.		
			E.B.B.	B.B.	Steel	E.B.B.	B.B.	Steel
4	0.225	730	2,190	2,409	2,701	6.44	7.53	8.90
6	0.192	540	1,620	1,782	1,998	8.70	10.19	12.04
8	0.162	380	1,140	1,254	1,406	12.37	14.47	17.10
9	0.148	320	960	1,056	1,184	14.69	17.19	20.31
10	0.135	260	780	858	962	18.08	21.15	25.00
11	0.120	214	642	706	792	21.96	25.70	30.37
12	0.105	165	495	545	611	28.48	33.33	39.39
14	0.080	96	288	317	355	48.96	57.29	67.71

The following paragraphs contain general information on galvanized iron and steel wire.

Properties	Iron	Steel	Copper
Percent of conductivity	16.80	12.2	100.0000
Microhms per centimeter cubed @ 0°C	9.50	13.1	1.5940
Microhms per inch cubed @ 0°C	3.74	5.17	.6276
Ohms per mile foot at 0°C.	57.20	78.9	9.5910
Ohms per mile foot at 20°C.	62.90	86.8	10.3600
Ohms per mile at 20°C	302,000 Cir. M.	417,000 Cir. M.	50,600 Cir. M.
Ohms per mile at 20°C.	332,000 Cir. M.	458,000 Cir. M.	54,600 Cir. M.
Pounds per mile ohm at 0°C	4230	5850	810
Pounds per mile ohm at 20°C	4700	6500	875

GENERAL NOTES. The following data, based on Roebling, give the average values for E.B.B. and B.B. iron wire.

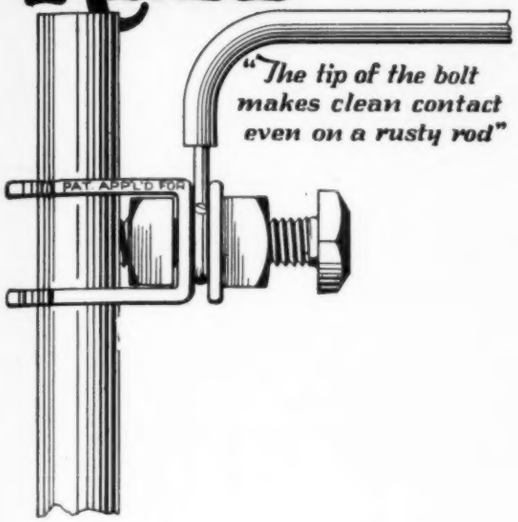
Mile ohm for E.B.B. wire	4,700
Mile ohm for B.B. wire	5,500
Mile ohm for Steel wire	6,500

COPYRIGHT 1923 J. B. RATHBUN
TELEPHONE ENGINEER COMPILED BY

HH-10-20

Mile ohm = weight per mile × resistance per mile.

KLING KLAMP FOR GROUND RODS



Why *Monkey* with Soldered Rods?

For ½-in. Rod.....15c each
For ⅝-in. Rod.....18c each

QUANTITY DISCOUNTS
100 lots.....10 per cent
1,000 lots.....20 per cent

THE SELF-CLEANING PROTECTION PLANT

PROTECT YOUR TELEPHONE SERVICE AS WELL AS YOUR EMPLOYES AND PROPERTY

Reliable Electric Company

3145 Carroll Avenue
CHICAGO, U. S. A.

Everstick

The standard anchor of companies whose engineering practice is standard for the industry.

Telephone companies of every size are using EVERSTICK Anchors because they are the best value in the world for holding hard and fast and for ease of installation.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

STEPHENS

CLIMBERS

Straps, Belts and Safetys

W. H. BUCKINGHAM

BINGHAMTON, N. Y.

FOR SALE OR TRADE

A new telephone exchange with 125 subscribers. 100-acre fruit farm close by. Fine proposition for married man. For particulars address J. K. Johnston, 903 Lemcke Bldg., Indianapolis, Ind.

PEERLESS Automatic Water Stills
Absolutely pure water for less than one or two cents a gallon, no matter how polluted your supply of water may be. For drinking, chemical or battery purposes the Peerless stills give you the best, ample supply at lowest cost.
Operated without attention other than occasional cleaning.
Write for complete details
SPARTA MFG. CO.
111 S. Hill Street South Bend, Ind.

$37.50 Addressograph

CHEAPER than typewriter—SAVES 20% of YOUR present costs — 5 to 15 times FASTER and BETTER than pen or typewriter.
FREE TRIAL will prove it!
Easy Pay't. Terms
No. 780 3-23
909 W. Van Buren St., Chicago, Ill.

HELP WANTED—Telephone cable splicer, thoroughly experienced, to locate trouble by means of a wireless test set. No other need apply. Permanent position. Apply Citizens Independent Telephone Co., 120 S. Seventh St., Terre Haute, Ind.

ALTERNATING CURRENT (EE-8-20)

ALTERNATING CURRENT CIRCUITS

RESONANCE. When an inductance and capacity are inserted into an alternating current circuit, so proportioned that they exactly neutralize the lagging or leading voltages of the other, then the only electromotive force acting in the circuit is the impressed electromotive force and there will be no phase displacement. This condition is called "Resonance."

When the capacity and inductance neutralize one another in an alternating current circuit, the only opposition offered to the current is the ohmic resistance, hence the flow of current under these conditions is governed by ohm's law. There is only one frequency at which resonance can take place with a given value of inductance and capacity for with an increased frequency the self-induction increases while the opposition of the capacity decreases.

The fact that the opposing inductances and capacities often set up voltages far in excess of the impressed voltage is of the greatest interest in the study of resonant circuits. Circuits which may have a non-resonant applied voltage of 440 volts, may build up potentials in excess of 10,000 volts at the terminals of the inductance and capacity when in a resonant condition.

INDUCTANCE AND CAPACITY RELATIONS. When an inductance is inserted into an alternating current circuit, the impressed E.M.F. waves will combine with the E. M. F. waves set up by inductance to form resultant E.M.F. waves which actually cause the current to flow. The resultant current is in phase with the resultant voltage, since the E.M.F. must act at the same instant as the current flow. Since the E.M.F. due to the inductance is 90 degrees behind the current, it also lags behind the resultant E.M.F. which is in phase with the current. The algebraic sum of the instantaneous values of the resultant and inductive E.M.F.'s will give the value of the impressed E.M.F., or:

IMPRESSED E.M.F. = RESULTANT E.M.F. + INDUCTIVE E.M.F.

When a condenser is placed in circuit, the capacity effect is such that the condenser E.M.F. is 90 degrees ahead of the current, and hence 90 degrees ahead of the impressed E.M.F. since the impressed E.M.F. causes the current to flow until the impressed and condenser E.M.F.'s become equal.

From the above it will be seen that the phase of the current in respect to impressed E.M.F. will change whenever an inductance or capacity is placed into the circuit. Either item will reduce the flow of current over that existing in a circuit where there is no reactance. One sets up an E.M.F. that is 90 degrees ahead of the current, while the other sets up an E.M.F. which is 90 degrees behind it. Thus, when an inductance and condenser are connected in series in a circuit they tend to neutralize each other and to bring the current and impressed E.M.F. into phase. When exactly equal, the resultant voltage will be equal to and in phase with the impressed E.M.F. and no other E.M.F. will be acting on the circuit. The circuit is now resonant.

The following are the general equations entering into the determination of resonance, where:

E = Impressed E.M.F. in volts.
I = Current in amperes.
R = Resistance in ohms.
J = Capacity in farads.
L = Inductance in henrys.
w = 6.2832 × frequency in cycles per second.

The following is the general equation for alternating current flow:

$$I = \frac{E}{\sqrt{R^2 + (wL - \frac{1}{wJ})^2}}$$

COPYRIGHT 1923
TELEPHONE ENGINEER
COMPILED BY
J. B. RATHBUN
EE-8-20

ALTERNATING CURRENT (EE-8-21)

ALTERNATING CURRENT CIRCUITS

RESONANT CIRCUITS CONTINUED.

Since the inductance varies inversely as the capacity effect at a given frequency constant (w), we have the following condition in a resonant circuit when the capacity exactly neutralizes the inductance:

$$wL = \frac{1}{wJ} \text{ or } wL - \frac{1}{wJ} = 0$$

These values when placed in the general formula for current flow cancel out and give the equivalent of ohm's law, or I = E/R. This shows that the current flow is governed by the ohmic resistance when all varying quantities are in phase.

In the following equations, the small unit called the "micro-farad" is used as the basic unit of capacitance, the farad, is far too large for practical work. The micro-farad is the 1,000,000 part of a farad. It will be designated by the symbol (j).

$$wL = \frac{1{,}000{,}000}{wj}$$

$$\text{Hence } w = \frac{\sqrt{1{,}000{,}000}}{Lj}$$

But since w = 6.2832f or = 6.2832 × frequency, by definition, then we have the frequency at which resonance takes place with a given inductance and capacity expressd by:

$$f = \frac{1}{6.2832} \times \frac{\sqrt{1{,}000{,}000}}{Lj}$$

POTENTIALS DUE TO RESONANCE. The voltage required across the terminals of an inductance to force a given current through it is expressed by: e′ = wLI Since the circuit follows ohm's law under conditions of resonance, or I = E/C, we can substitute the inductance potential in ohms law and obtain the following:

$$e' = \frac{wEL}{R}$$

The voltage required to send a given current through a condenser is given by

$$\frac{I \times 1{,}000{,}000}{wj} = \frac{E \times 1{,}000{,}000}{wRj}$$

The last term of the expression shows that the smaller the ohmic resistance (R) becomes, the greater will be the local voltages set up by the inductance and capacity. In the form of an equation:

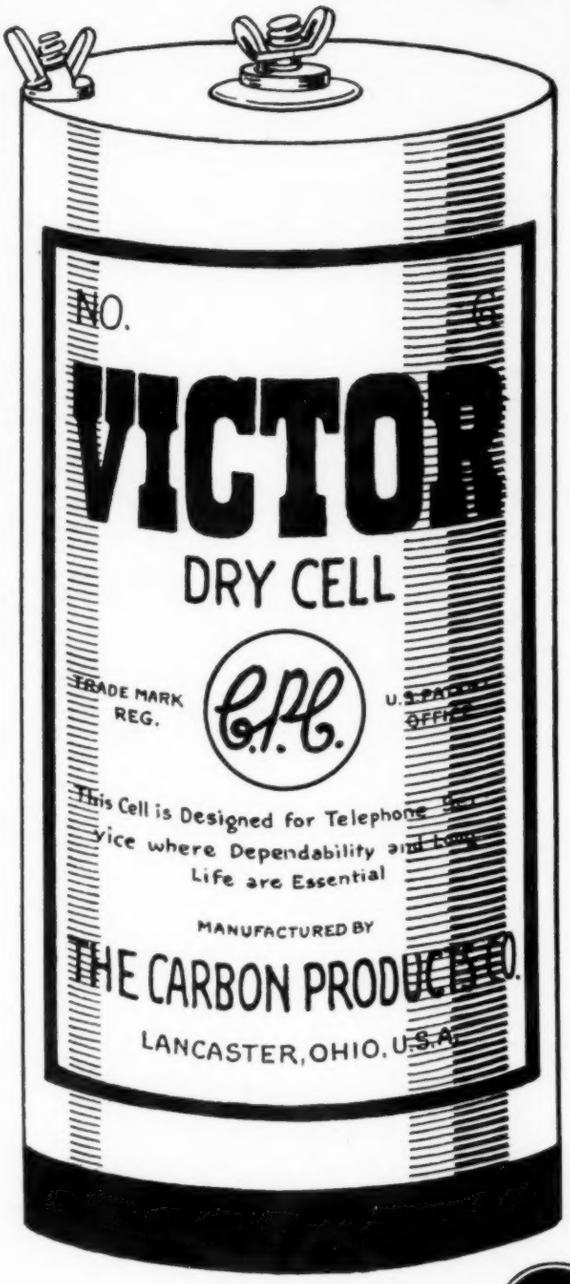
$$e' = \frac{6.2832ELf}{R}$$

This is the voltage at the ends of the inductance. At the terminals of the condenser we have:

$$e'' = \frac{1{,}000{,}000 \times E}{6.2832 \times R \times f \times j}$$

COPYRIGHT 1923
TELEPHONE ENGINEER
COMPILED BY
J. B. RATHBUN
EE-8-21

Guaranteed Telephone Service



This is the battery with twelve months actual telephone operating service.

The battery that is the vital, life-giving part of your telephone — the actual source of electrical energy that helps keep the good will of all your subscribers, and at the same time reduce your operating expenses to a minimum.

There is no added cost for Victor service.

Meet us at the Chicago convention and learn many other reasons why you should use Victor Telephone Batteries.

C.P.C.

The Carbon Products Co.
LANCASTER, OHIO

Customer Ownership Facts

Important Principles Which Underlie the Movement —Great Opportunities Which It Affords for Service to the Public and the Nation as Well as the Utilities

E. K. Hall, Vice-President of the American Telephone and Telegraph Co., told the National Electric Light Association recently that, since his company started on that general plan, its customers have become partners to the extent of 871,000 shares, distributed among 185,000 people, and the company finds that fact to be extremely helpful in its business. It brings them closer to the people they are trying to serve and establishes a co-operative, worked-out-together relation that is much more comfortable.

"I hope," says Mr. Hall, "that all of us in this customer ownership proposition will not feel that our work is done when our customers have become stockholders, but will follow that up with information about the business, about the problems of the business and about the principles of public utilities as related to the general public and to Government. We need to have the public understand that we have no other job on earth but to furnish them service, and to set up such a relationship with them that they will feel free to tell how they want that service."

Education Begins at Home

"I would especially like to emphasize the desirability of our own people, being part owners in the business," says Mr. Hall. "If we are going to interpret this public utility business to the public, then it has got to be done, not by the management, not by a few people at the top, but by the whole outfit. They have got to know the principles and the policies. They are the ones who can make the public understand and bring the public into a sympathetic understanding with the utilities. If they come into the business as partners, this becomes the natural, easy thing for them to do."

"This whole thing is but an attitude of mind. What is the attitude of a given man toward a public utility company? Does he think the company is in business simply to make a lot of money? If that is his attitude of mind, he is wrong. The public utility can't make a lot of money. The public utility is limited to a fair return on investment.

Making "The Gang" Realize the Truth

"It is the same way with 'the gang' on the job—in the field. What is their attitude toward the company they work for? Do they consider it a sort of unknown organization where they come once a week and get their pay check, or do they realize it is a combination of capital and muscle and brains and pep welded together to give the public what they must have—public service?"

"If the gang gets to feel that they really belong; if they talk these things over and learn something about the policies of the company and the financing of the company and they take an interest in keeping the company sound and successful, they also can interpret the company to outsiders infinitely better than they otherwise would."

Teaching the Public How to Invest

"Now there is another thought that I would like to emphasize in this connection of customer ownership: Just a few issues of bad public utility securities can hurt us all and make the small investor lose confidence in the whole proposition.

"If every one of us will see to it that nothing but gilt-edge, first-class securities are sold to the small investors, then we are rendering, besides helping ourselves, a great service to the individual who buys securities. Probably 50 per cent of all the inhabitants of the United States have no idea today how to invest money. The average small investor hesitates to go into a bank; he is a little bank shy. He does not think they want to waste time, perhaps, with just his small savings of $100, that he wants to invest somewhere. It should be made very easy, however, for him to come and talk with the people of his own town—with his own public utility people. Everything that we can do should be done to bring in such people who want to invest money; who would like to have some securities if they knew how and where they could safely purchase them—anything to establish a friendly contact between them and the public utilities of the United States, where a man can invest in something that he can see (the poles and the wires and other tangible evidence of where his money has gone). It gives him a sense of security and it is a magnificent thing for him to get started thus."

Millions Are Lost by Fraud

"The Better Business Organization estimates that $700,000,000 a year in the United States is turned over to fraudulent promoters. It would not take very much more than that to keep building the public utilities of the United States and their extensions for an indefinite time in the future. If the money of the people who are now being buncoed could be turned into public utilities which are among the soundest securities in the country, we would not only solve our own financing, but do the individual investor a tremendous favor and the public a great good.

"Securities are sold to investors that aren't good. It would be a bad thing for the social order in this country of ours if we destroy the confidence of the small investor in our social order. If his first little experiment in saving and investing turns out wrong, he will lose confidence, in all probability, rapidly in the whole plan.

Extent of Investment Money

"The national income of the U. S. A. is about $60,000,000,000. Sixty per cent of that goes to people of less than $2,000 a year income, and 52 per cent of it goes to the wage earners. Those are the people who are going to buy public utility stocks in customer ownership. A list of the people who came in partnership with one of our companies recently is interesting. They included: lawyers, teachers, clergymen, Government employees, newspaper men, manufacturers, bankers, barbers, blacksmiths, boilermakers, butchers, carpenters, chauffeurs, cooks, mechanics, firemen, waiters, shoemakers, housemaids, housewives, farmers—and you might be interested further to know that housewives headed the list."

"Nothing can be better for this country than to have its people becoming the owners in the great service companies; to have them get the habit not of wasting but of saving, and of putting their money into safe investments where it is producing for the country—nothing more advantageous could happen for this nation."

"All the countries of Europe are struggling along with poor public service. Why? Because they have tried to develop it through Government ownership. Through customer ownership, see what a wonderfully better thing we have. The whole people are going to own the utilities. In the next twenty years, these securities are going to be even more widely distributed. That will bring about a better understanding between the public utilities and people.

What Men in the Telephone Industry
THINK OF THE
P. U. R. Question Sheet Plan

Comprehensive Yet Concise

Southwestern Bell Telephone Company, J. K. Wass, General Auditor, St. Louis, Mo.

"* * * as to the P. U. R. Question Sheets would say that you are covering the various phases of the utility business in a comprehensive yet concise manner."

Educational

The Bell Telephone Co. of Penna., A. H. Osterman, Gen. Commercial Supt., Philadelphia, Penna.

"The general consensus of opinion is that these questions are highly interesting and educational and the manner in which they have been prepared creates a decidedly favorable impression. The arrangement of the material segregating questions and answers is in my mind a very good feature of the paper, as it enables the reader to frame an answer of his own before being tempted to look for the answer given.

"Another very favorable comment which has been made is that the questions are treated in a very practical way and offer the average telephone man a very good opportunity to post himself on the important current decisions affecting public utility work, without going too deeply into the academic discussions of the various subjects."

Food in Concentrated Form

Navajo-Apache Telephone System, Lloyd C. Henning, Sec. & Treas., Holbrook, Ariz.

"It seems to me that the idea is a good one and it is in reality a correspondence course without the individual effort necessary to think out and look up the answers. In other words we are getting food in concentrated form. The idea appeals to me very much, personally. I was always keen for correspondence courses until it came to the actual work of finishing them. This idea, too, is eliminated. I believe that at the end of the year, with an excellent cross index, it would be a valuable textbook."

Likes the Plan

South Atlantic Tel. & Tel. Co., F. W. Webster, Gen. Mgr., Miami, Fla.

"* * * the Question Sheets issued by you, in conjunction with the Reports, impress me as being an excellent medium of directing the reader's attention to those points most important to him. I like the plan."

Answers Clear and Thorough

The New Brunswick Tel. Co., Ltd., O. J. Fraser, Gen. Supt., St. John, N. B.

"* * * I have been studying these very carefully as they are received and I consider they are of great value to any person connected with any public utility. The clearness and thoroughness of the answers can leave no doubt in the minds of the readers as to what is meant. Personally, I find them a great help."

Valuable, Even with Other Material

Northwestern Bell Telephone Co., A. J. McBean, Atty., Omaha, Nebr.

"We have found these Question Sheets of value in calling our attention to points in recently reported cases. While we have other means of keeping in touch with current decisions, your Question Sheets have been useful in calling our attention to points which might possibly otherwise have escaped us."

No Research Required

Macon Telephone Company, R. A. Guthrie, President, Macon, Mo.

"* * * relative to the views of the P. U. R. Question Sheets, I wish to say that we think they are especially helpful to the average utility manager, as the bring out points that he is interested in directly, and without the necessity of searching though numerous opinions and findings of the commissions and courts * * *."

A Very Useful Service

The Chesapeake & Potomac Telephone Co., T. B. Milne, Asst. Atty., Washington, D. C.

"* * * as to the P. U. R. Sheets, I think that these Sheets perform a very useful service, inasmuch as they draw attention to any very vital points which may have cropped up in the different cases."

Manner of Presentation Good

Coles County Telephone & Telegraph Co., Mattoon, Ill.

"The information contained in the P. U. R. Question Sheets is useful and to the point. We like the way the information is presented."

Very Satisfactory

Indiana Bell Telephone Co., C. H. Rottger, Pres., Indianapolis, Ind.

"The P. U. R. Question Sheets are a very satisfactory supplement to the reporting service."

Subscription price—$25.00 a year. For further information, address:

PUBLIC UTILITIES REPORTS, Inc.

934 Munsey Building, Washington, D. C.

When you set a

Never-Creep Anchor

NEVER CREEP
THE NEVER CREEP CANNOT CREEP IT PULLS AGAINST THE SOLID UNDISTURBED EARTH
ALL DISTURBED AND MOISTURE EFFECTED EARTH IS BACK OF THE NEVER CREEP

no room is left for an argument

"It's in solid"

No "pull" can make this anchor waver a bit in its fidelity to your interests.

It has a heart of iron, it is strong and long-lived.

It stays where you want it to stay, and goes there without any great expense.

It's the only anchor with the Thimbleye—the improvement that preserves the guy wire and makes installation easy.

This space won't permit the whole story but our booklet does—want it?

This is the Never-Creep's Patented Thimbleye that makes the guy wire's life longer, and installation easier.

CHANCE COMPANY

Anchors, Socket Wrenches, Protectors, Brackets, Back Trusses

CENTRALIA, MO.

Bonitas *for Speed*

Your linesman can double his day's work with Bonita Aerial Cable Rings. Just

Grip—Squeeze—Snap

and the hanger is ready for the cable. Another reason why there are over 50 million used.

Standardized by A. T. & T. Co.

CAMERON APPLIANCE CO.
EVERETT, MASS.

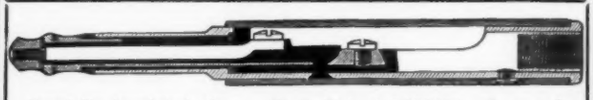
Douglas Fir Cross Arms

Afford great strength, long durability and light weight

Best for all climates and conditions

Send inquiries for prices by letter or wire to

INTERNATIONAL CROSSARM CO.
BELLINGHAM, WASH.
or CAMERON LUMBER CO., Ltd., Victoria, B. C., Can.



Specially insulated plugs. U. S. Patent 1302471. In use in five continents. Prices c. i. f. any place.

TELEFON FABRIK AUTOMATIC
7. AMALIEGADE COPENHAGEN DENMARK

CEDAR POLES

NORTHERN + WESTERN
BUTT-TREATING - GUARANTEED GRADES
ANY SPECIFICATIONS REQUIRED
BELL LUMBER CO., Minneapolis, Minn.

CEDAR POLES

Wire or write us for delivered prices

NATIONAL POLE CO., Escanaba, Mich.
220 Broadway, New York
2844 Summit Street, Toledo, Ohio
Rialto Building, San Francisco

"REBUILT" TELEPHONE APPARATUS and exchange equipment saves you 30 to 50 per cent without sacrificing quality or efficiency.

SWITCHBOARDS—Telephones—Apparatus—Protection Equipment—Cable—Everything you need for the installation and operation of a complete exchange—Magneto or Central Energy—of the best and most reputable manufacturers.

Fourteen years' successful operation of our rebuilt equipment department puts it past the experimental stage. Quality and price will make you a permanent customer. Better investigate.

BARGAIN BULLETIN NO. 78 FREE

Address "REBUILT" EQUIPMENT DEPARTMENT
Premier Electric Company 1800-4 Grace St. Chicago, Ill.

MANUFACTURERS OF

9 Duct

VITRIFIED, GLAZED, CLAY CONDUIT

We carry large stocks of round singles, square single, two, three, four, six and nine duct, in standard and short lengths, splits, mitres and bends.

SERVICE and QUALITY
GUARANTEED

THE CLAY PRODUCTS CO.
BRAZIL, INDIANA

TIREX NEVER KINKS

TIREX RUBBER ARMORED CORD
FOR ELECTRIC TOOLS

Two or three conductor Nos. 18, 16 and 14 and two conductor No. 12 are packed in special cartons containing 250 feet each, so constructed that the cord may be drawn out as needed without disturbing the remainder of the coil. All sizes are furnished in special lengths as ordered.

SIMPLEX WIRE & CABLE Co
MANUFACTURERS
201 DEVONSHIRE ST., BOSTON 9
CHICAGO SAN FRANCISCO NEW YORK

"INDIANA"
TELEPHONE AND TELEGRAPH WIRE

PROVEN BEST BY TEST

Time and the aid of America's foremost engineers, have enabled us to develop and manufacture the highest grade wire known to the trade. It is greatest in conductivity and lasting qualities, due to the superior quality of material from which it is made, as well as its *Extra Double Galvanizing*, which insures longest life.

STEEL STRAND

Single and Double Galvanized, Standard, Siemens-Martin, High Strength and Extra High Strength Grades.

HANDLED BY MOST JOBBERS

MANUFACTURED BY
INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

HEMINGRAY
Standard
Glass Insulators
FOR EVERY TELEPHONE USE

Large Stocks Maintained
Immediate Deliveries

Hemingray Glass Co.
Muncie, Indiana

Ten Years' Record in Wood Preservations

A detailed report on the quantity of wood treated and preservatives used in the United States in 1922 and previously, has been prepared by the U. S. Forest Service in co-operation with the American Wood-Preservers' Association, and will soon be ready for distribution. A resume of this report, printed below, shows some facts which should interest users of treated wood and furnish food for thought to those who have any doubt as to the practicability or suitability of treated wood.

Despite the fact that conditions during the past 10 years have not been conducive to increased business generally, it is encouraging to report an increase in the output of treated timber and in the number of plants operating. In 1913 the railroads utilized about 90% of all the timber treated, and operated 40% of the 93 plants. In 1922 they used about 80% of the total output and operated about 22% of the 128 plants. Since the railroads are using a greater quantity of treated timber than ever before, these figures show that there has been a substantial gain in the consumption of treated timber for other than railroad purposes.

Railroads Believe in Preservatives

The high record of production was reached in 1921 when 201,643,228 cubic feet of timber were treated. A slight falling off occurred in 1922, directly traceable to the financial retrenchments of the railroads, the largest users of treated material, combined with the car shortage and coal strike that affected the operation of treating plants.

The great variety of timber utilized by farms, mines, factories and specialized industries, offers exceptional opportunity for continued growth. More attention is also being devoted to the use of treated lumber in railway car construction.

A comparison of the output of treated timber in 1913 with the period from 1918 to 1922, inclusive, shows as consistently as possible the recovery that has been made since the world war.

For years cross-ties constituted over 75% of all the timber treated in the United States. Approximately one-half of the annual tie requirements of the railroads are treated. Of the cross-ties treated in 1922 nearly 50% were treated with creosote, 42% with zinc chloride, and most of the remainder with a mixture of zinc chloride and creosote. The calculated average absorption of preservatives per cubic foot of the cross-ties treated in 1922 was: Creosote, 6.59 pounds; zinc chloride, 0.5 lb.; zinc chloride and creosote, 0.5 lb. and 2.74 lbs., respectively. Over 15% of the 41,316,474 cross-ties treated in 1922 were either adzed or bored, or both, before treatment.

In 1921 the output of creosoted piles touched the low mark during the past 10 years. In 1922 the volume jumped 25% to 11,085,005 linear feet. The average absorption of creosote was 13.3 lbs. per cubic foot. In recent years a few piles were treated with zinc chloride, the average absorption being 0.5 lb. per cubic foot. The species treated, in order of volume, were southern pine, Douglas fir, cypress, and cedar.

Treated Poles Grow in Popularity

In 1922 a total of 966,400 poles were treated, the largest number ever reported. Comparing the number treated in 1922, when 37.5% of the poles were pressure treated, with 1920 when the ratio was 28%, there is shown an increase of 122%. Cedar and chestnut butt treated poles in the same period increased 46%. The pressure treated poles received an average of 9.4 lbs. of creosote per cubic foot.

MATERIAL TREATED IN UNITED STATES, 1913 TO 1922

Kind	1913	1918	1919	1920	1921	1922
Cross-ties (No.)	40,260,416	30,609,209	37,567,927	44,987,532	55,383,515	41,316,474
Piles (Lineal ft.)	11,766,852	12,286,518	13,557,519	11,965,912	8,268,519	11,085,005
Poles (No.)	142,069	262,260	378,481	585,781	622,685	966,400
Wood blocks (Sq. yd.)	2,611,921	2,398,969	1,795,683	2,568,171	2,363,011	1,503,879
Cross-arms (No.)	2,944,045	683,077	121,507	514,209	175,403	604,758
Const. Timbers (Bd. ft.)	138,843,536	122,587,116	144,742,476	139,749,732	142,520,496	152,556,960
Misc. Lumber (Bd. ft.)	24,475,896	11,086,356	8,113,632	14,864,268	9,037,212	13,560,432
All Material, Total (Cu. ft)	153,613,888	122,612,890	146,060,994	173,309,505	201,643,228	166,620,347
Plants in Operation	93	107	108	115	122	128

New President for Keystone of Philadelphia

Percival E. Foerderer, prominent business man of Philadelphia, has been elected to the presidency of the Keystone Telephone Co. vice Nathan T. Folwell, president of the company since 1905. Mr. Folwell, whose health is impaired, has been elected chairman of the board of directors.

U. S. To Be Center of Radio World.

The Radio Corporation of America has in the United States five high-power radio telegraph stations employed in transoceanic service. Since 1920, the United States has become the greatest center of radio communication in the world, operating as many high-power commercial stations as all other countries combined. This is a record of scientific achievement and business enterprise of which all Americans have a reason to feel proud.

SALESMAN WANTED: The Everhot Mfg. Co., Maywood, Ill., desires to get in touch with a salesman now selling to telephone companies, and show him how he can earn additional weekly compensation.

POSITION WANTED: First-class cable-splicer, thoroughly experienced on cleaning all kinds of trouble and installing new systems. Prefer permanent, but will consider temporary, position. Ten years' experience. Go anywhere. Address: L. V. Longenecker, Box 199, Hamilton, Ill.

CEDAR POLES
Northern White Western Red
Quick delivery, prices and quality satisfactory
J. J. SEGUIN
579 Saint John Street QUEBEC CITY, P. Q., CAN.

LOCUST AND OAK PINS AND BRACKETS

4"x30" special and standard Pins made of the very best stock obtainable. We use most modern methods and employ experts.
Remember the trademark, stamped only on pins and brackets that last and give you real service.
Write for quotations.
COTTAGE PLANING MILL CO., Everett, Pa.

ENGINEERS FOR TELEPHONE EQUIPMENT WORK
The telephone business has grown tremendously during the past year and the end is nowhere in sight. A real future is offered to men who are interested in permanent work.
Technical men, as well as those who are capable of becoming engineers, will find it to their advantage to write
R. T. Barker
WESTERN ELECTRIC CO., INC.
Hawthorne Station Chicago, Illinois